

Daily report

22-06-2020

Analysis and prediction of COVID-19 for EU-EFTA-UK and other countries

Situation report 92

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With the financial support of:

Foreword

The present report aims to provide a comprehensive picture of the **pandemic situation of COVID-19** in the EU countries, and to be able to foresee the situation in the next coming days.

We employ an **empirical model**, verified with the evolution of the number of confirmed cases in previous countries where the epidemic is close to conclude, including all provinces of China. The model does not pretend to interpret the causes of the evolution of the cases but to permit the **evaluation of the quality of control measures made in each state** and a **short-term prediction of trends**. Note, however, that the effects of the measures' control that start on a given day are not observed until approximately 7-10 days later.

The model and predictions are based on two parameters that are daily fitted to available data:

- ✓ a : the velocity at which spreading specific rate slows down; the higher the value, the better the control.
- ✓ K : the final number of expected cumulated cases, which cannot be evaluated at the initial stages because growth is still exponential.

We show an individual report with 8 graphs and a table with the **short-term predictions** for different countries and regions. We are adjusting the model to **countries and regions** with at least 4 days with more than 100 confirmed cases and a current load over 200 cases. The **predicted period** of a country depends on the number of datapoints over this 100 cases threshold, and is of 5 days for those that have reported more than 100 cumulated cases for 10 consecutive days or more. For short-term predictions, we assign higher weight to last 3 points in the fittings, so that changes are rapidly captured by the model. The whole methodology employed in the inform is explained in the last pages of this document.

In addition to the individual reports, the reader will find an initial dashboard with a brief analysis of the situation in EU-EFTA-UK countries, some summary figures and tables as well as **long-term predictions** for some of them, when possible. These long-term predictions are evaluated without different weights to datapoints. We also discuss a specific issue every day.

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(0) Executive summary – Dashboard

Situation and highlights

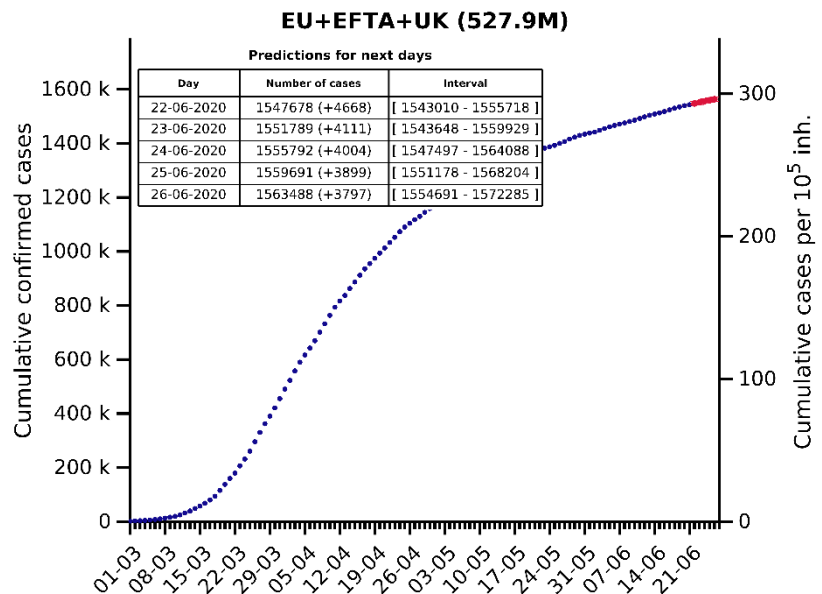
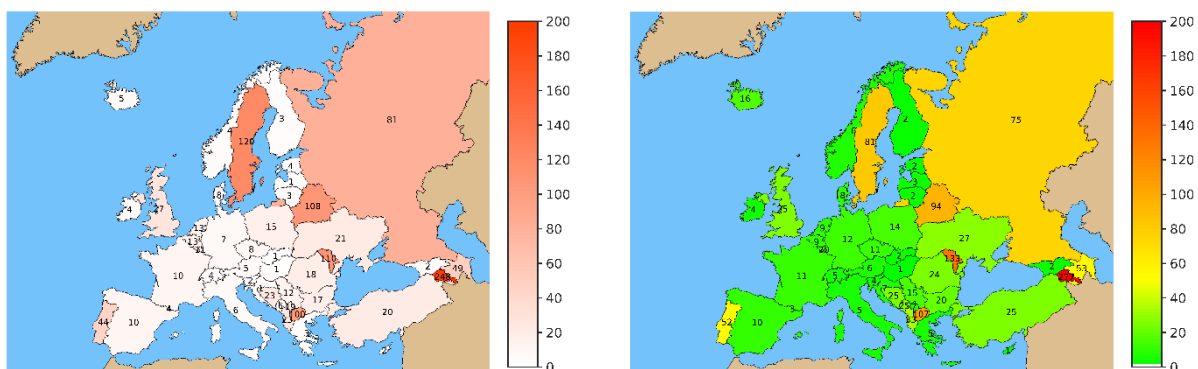
The global situation in EU+EFTA+UK countries follows the trend of last week, with the daily new cases at the range of 4,000-5,000.

The local outbreaks detected last week in **Germany** are noticeable at the country level. The number of active cases has increased from 26.1 per 100,000 inhabitants last Friday to 35.3, while the empiric reproductive number p_7 has raised up to 1.65. Nevertheless, these numbers are still far from significant risk at the country level, as shown by the EPG index, which remains at the low risk zone.

This is also seen in the risk diagram as an upward shift of the curve. If this situation is not followed by significant community transmission, the curve should move down again in the following days. Otherwise, if these outbreaks have generated significant transmission, we could observe a rightward shift of the curve (i.e., a significant increase in active cases).

Spain is showing several fluctuations in p_7 as a result of the combination of some delays in data recording together with isolated small local outbreaks. Nevertheless, and as seen in its risk diagram, these fluctuations occur in a low risk situation. **Sweden** has not reported new cases for the last 4 days. Therefore, the spreading and risk indexes are not reliable. **Portugal's** dynamics is still not clear, with a new increase in p_7 and 185 active cases per 100,000 inh. It remains at the intermediate-risk zone, but situates at degree 5 in the Biocom-Cov scale. The situation in **Romania** is worrying as well, with a sustained increase in new cases for the last days ($p_7=1.3$). **Bulgaria** is also reporting a significant increase in new cases.

The map in the left shows current **A₁₄**. The map in the right shows current **EPG**.



Situation and trends per country

Table of current situation in EU countries. Colour scale is relative except when indicated, this means that it is applied independently to each column, and distinguishes best (green) from worst (red) situations according to each of the variables. Last column (EPG_{EST}) is assessed with **estimated real 14-day attack rate** (see report from 22/04 for details). EPG_{REP} is calculated with **data reported by countries**. EPG_{REP} and EPG_{EST} **cannot be compared between them** because scales are different, but can be independently used for estimating risk of countries according to reported or estimated real situation, respectively.

Country	Reported data								Indexes			
	Cumulative cases	Attack rate /10 ⁵ inh.	Cumulative deaths	Mortality /10 ⁵ inh.	Active cases (last 14 days)	14-day attack rate /10 ⁵ inh.	Estimated active cases (last 14 days)	Estimated 14-day attack rate /10 ⁵ inh.	$p_7^{(1)}$	$EPG_{REP}^{(2)}$	$EPG_{EST}^{(3)}$	Biocom-Cov degree
United Kingdom	304.331	458,1	42.632	64,2	18.137	27,3	258.586	380,9	0,93	25	354	4
Spain	246.272	531,4	28.323	61,1	4.722	10,2	55.103	117,2	1,06	11	124	3
Italy	238.499	401,3	34.634	58,3	3.501	5,9	50.644	83,8	0,83	5	70	2
Germany	190.359	232,4	8.885	10,8	6.166	7,5	29.551	35,3	1,65	12	58	3
France	160.377	247,8	29.640	45,8	6.400	9,9	121.703	186,5	1,09	11	204	3
Belgium	60.550	533,1	9.696	85,4	1.324	11,7	21.588	186,3	0,81	9	152	3
Sweden	56.043	569,7	5.053	51,4	11.313	115,0	106.051	1.050,1	0,73	84	764	7
Netherlands	49.593	291,9	6.090	35,9	2.019	11,9	25.270	147,5	0,77	9	114	3
Portugal	39.133	377,3	1.530	14,8	4.640	44,7	18.873	185,1	1,14	51	211	5
Poland	31.931	83,5	1.356	3,5	5.370	14,0	23.804	62,9	0,98	14	62	3
Switzerland	31.209	364,2	1.680	19,6	327	3,8	1.781	20,6	1,33	5	27	2
Ireland	25.379	537,0	1.715	36,3	178	3,8	1.236	25,0	0,98	4	24	2
Romania	24.045	121,6	1.512	7,6	3.566	18,0	24.443	127,1	1,30	23	165	4
Austria	17.285	198,4	690	7,9	417	4,8	1.734	19,3	1,25	6	24	2
Denmark	12.391	216,9	600	10,5	443	7,8	2.179	37,6	1,07	8	40	2
Czech Republic	10.498	98,9	336	3,2	870	8,2	2.964	27,7	1,38	11	38	3
Norway	8.708	162,2	244	4,5	204	3,8	541	10,0	1,68	6	17	2
Finland	7.143	129,8	326	5,9	162	2,9	744	13,4	0,53	2	7	1
Luxembourg	4.120	715,3	110	19,1	81	14,1	222	35,4	1,52	21	54	3
Hungary	4.102	42,1	572	5,9	132	1,4	1.686	17,4	0,50	1	9	1
Bulgaria	3.905	54,8	199	2,8	1.178	16,5	7.266	104,6	1,18	19	123	3
Greece	3.266	29,2	190	1,7	314	2,8	1.758	16,9	1,53	4	26	2
Croatia	2.317	55,0	107	2,5	70	1,7	333	8,1	3,93	7	32	2
Estonia	1.981	151,0	69	5,3	42	3,2	NA	NA	0,59	2	NA	1
Iceland	1.823	500,5	10	2,7	16	4,4	NA	NA	3,35	15	NA	3
Lithuania	1.798	61,8	76	2,6	84	2,9	NA	NA	0,73	2	NA	2
Slovakia	1.587	29,2	28	0,5	59	1,1	NA	NA	2,02	2	NA	1
Slovenia	1.520	73,1	109	5,2	35	1,7	256	12,3	2,29	4	28	2
Latvia	1.111	56,4	30	1,5	23	1,2	NA	NA	2,23	3	NA	2
Cyprus	986	84,3	19	1,6	22	1,9	NA	NA	0,28	1	NA	1
Malta	665	155,0	9	2,1	36	8,4	NA	NA	NA	NA	NA	2
Liechtenstein	83	215,3	1	2,6	0	0,0	NA	NA	NA	NA	NA	0

Scale											
Worst	Worst	Worst	Worst	Worst	Worst	Worst	Worst	Worst	2,0	100	1000
Best	Best	Best	Best	Best	Best	Best	Best	Best	0,0	0	0

Disclaimer: estimated active cases and estimated 14-day attack rate are assessed by assuming a lethality of 1 % (see report from 20 to 24 April, #37-41). This value can change in countries where suspicious deaths are reported as well (real values would be lower) and in countries where incidence among elderly people was minor (real values would be higher)

⁽¹⁾ p_7 is the average of 7 consecutive p , but can still fluctuate. ^(2,3) EPG stands for Effective Growth Potential. EPG_{REP} is the product of attack-rate of last 14 days per 10⁵ inhabitants by p_7 (empiric reproduction number). EPG_{EST} is the product of estimated real attack-rate of last 14 days per 10⁵ inhabitants and p_7 . Biocom-Cov degree is an epidemiological situation scale based on the level of last week's mean daily new cases (<https://upcommons.upc.edu/handle/2117/189661>, <https://upcommons.upc.edu/handle/2117/189808>).

Analysis: How to evaluate the increase in epidemiological risk due to tourism.

The economic crisis is one of the major consequences of the pandemic. Many companies, families and people are going through very important difficulties. One of the sectors most affected by control measures is, undoubtedly, tourism. In fact, there are many cities and countries that strongly depend on tourism income. It is therefore very important to move progressively towards normality. In the same way, it is important that secondary epidemic outbreaks are not triggered. **The increase in risk that tourism can cause must be assessed, in order to minimize it.** One can wonder whether it is necessary to set thresholds for risk, perhaps by defining some limitations to tourism according to origin.

The risk diagram has shown to be an excellent tool for assessing the epidemiological situation in each region. It shows the temporal evolution of the number of reported active people per 100,000 inhabitants ($A_{14}(t)$) and the empirical reproductive number ($\rho_7(t)$). A good strategy for assessing the risk situation, including the presence of visitors, would be its modification to include the effect of tourism.

How to build the risk diagram to account for the effects of mobility between regions

If we know the typical origin of visitors in a certain region, we can evaluate different scenarios. The first one is to assume that the region will have the same visits as in 2019. In this case, information about number of visitors, region and country from where they come from, and duration of stays should be available, together with the incidence of covid-19 in the origin's regions.

We can start preparing an average list of positive cases considering the population of the recipient region and the number of visitors from each origin, for the last 21 days. To do so, let us denote $N_i(t)$ the number of diagnosed cases in the region i at day t , $i = 1$ being the recipient region and $i > 1$ all the visitors' origin regions. If P_i is the total population of the region i , the number of positives per 100,000 inhabitants will be:

$$n_i(t) = \frac{N_i(t)}{P_i} \cdot 10^5$$

We can build the series $n_i(t)$ from $t = -21$ days until $t = 0$ (current day) for each of the regions.

In order to minimize the weekend effect and the random noise, we can evaluate a 7-day moving average:

$$n_i(t) \rightarrow n_{7,i}(t)$$

Then, we will build the weighted average series using the number of visitors from each region, $v_i(t)$, and with $v_1(t) = P_1$ (population of the recipient region):

$$\bar{n}_7(t) = \sum_{i=1}^m n_{7,i}(t) \frac{v_i(t)}{10^5}$$

The averaged total population series will be:

$$\bar{P}_w(t) = \sum_{i=1}^m v_i(t)$$

Finally, **the weighted series of positive cases is:**

$$\bar{N}_w(t) = \frac{\bar{n}_7(t) \bar{P}_w(t)}{10^5}$$

This series can be directly used for assessing a weighted $\bar{A}_{14}(t)$. As for the $\bar{\rho}_7$, we can use the series per 100,000 inhabitants in order to bypass the effect of the daily increases and decreases in population:

$$\bar{n}_w(t) = \bar{N}_w(t) \frac{100000}{\bar{P}_w(t)}$$

The risk diagram can be finally built with the weighted series $\bar{A}_{14}(t)$ and $\bar{\rho}_7(t)$.

Other scenarios may be explored by assuming a fraction of usual visitors, or by using updated data about current visitors.

How to use the risk diagram to evaluate the effects of tourism

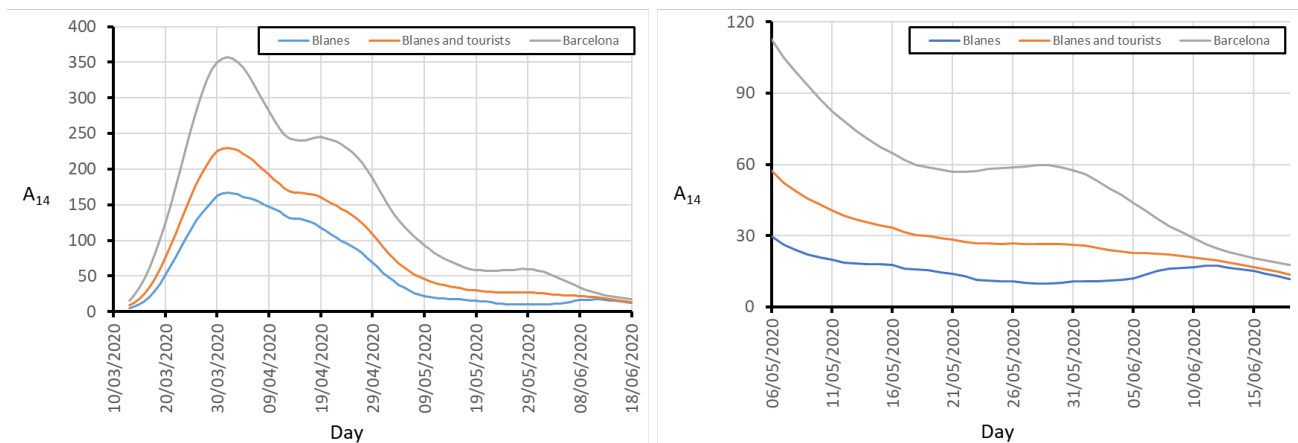
In order to evaluate the risk level, we must focus on $\bar{A}_{14}(t)$. If the number of estimated active cases overcomes a certain threshold, the probability of new outbreaks can increase and become important. The threshold between a low and an intermediate-high risk situation must be a decision of policy makers, taking into account the test and trace capacity of the region, among others. **A possible threshold for European countries is 30 active cases per 100,000 inhabitants.**

The dynamics of $\bar{\rho}_7(t)$ will be of interest whenever its value is determined by local transmission, i.e., if the number of tourists and their origin remains approximately constant. In that case, a $\bar{\rho}_7(t) > 1$ would be indicative of increasing the risk level.

Example

Blanes is a tourist city with a population of 39,028 inhabitants. Let us design a virtual experiment, assuming a daily arrival of 19,514 persons from Barcelona city (i.e., 50 % of Blanes population). During the pandemic, the situation in Barcelona has been much worse than in Blanes.

The next figures show the increase in $\bar{A}_{14}(t)$ in Blanes (orange, Blanes plus tourists) with regards to the $A_{14}(t)$ of Blanes without considering tourism (blue). We also show the $A_{14}(t)$ of Barcelona city (grey). Assuming the threshold of 30 active cases per 100,000 inhabitants, we see that Blanes alone (without tourists) was at intermediate-high risk until 6th May. Therefore, it was not recommendable to open the city to tourists before that date. Nevertheless, visitors from Barcelona would have significantly increased the risk until 18th May. Therefore, Blanes should have been closed to Barcelona's visitors until that day. Now, both Blanes and Barcelona are at low risk. Therefore, tourism does not increase the risk up to a compromised level.



Nevertheless, there is another factor that must be considered: **when the global number of visitors is significant (e.g., $\bar{P}_w(t) \approx 1.5P_1$), the epidemiological surveillance services must be re-dimensioned accordingly in order to guarantee the test and trace strategy.**

Conclusions

It only makes sense to open a region to tourism if its own epidemiological situation is acceptable. It is not recommendable to open a region where the incidence of covid-19 is significant, since the probability that tourists get infected would not be marginal. When a region is open to tourism, it is necessary to maintain the epidemiological situation inside the limits for the capacity for control (diagnosis, screening, hospitalizations). It is probably necessary to set a limit for the arrival of tourists to avoid reaching a dangerous situation. Assessing how epidemiological risk varies from the incidences of different regions can be a good tool to facilitate management.

Situation and trends in other countries

Table of current situation in a sample of non-EU countries. Colour scale is relative except when indicated, this means that it is applied independently to each column, and distinguishes best (green) from worst (red) situations according to each of the variables. EPG_{REP} and EPG_{EST} **cannot be compared between them** because scales are different, but can be independently used for estimating risk of countries according to reported or estimated real situation, respectively.

Country	Reported data								Indexes			
	Cumulative cases	Attack rate /10 ⁵ inh.	Cumulative deaths	Mortality /10 ⁵ inh.	Active cases (last 14 days)	14-day attack rate /10 ⁵ inh.	Estimated active cases (last 14 days)	Estimated 14-day attack rate /10 ⁵ inh.	$\rho_7^{(1)}$	EPG _{REP} ⁽²⁾	EPG _{EST} ⁽³⁾	Biocom-Cov degree
United States of America	2.280.912	689,1	119.975	36,2	338.549	102,3	1.883.619	569,1	1,17	120	666	7
Brazil	1.085.038	510,5	50.617	23,8	393.280	185,0	2.087.620	982,1	1,24	230	1.218	8
Russia	584.680	400,6	8.111	5,6	117.007	80,2	NA	NA	0,94	75	NA	6
India	425.282	31,4	13.699	1,0	168.671	12,5	673.053	49,7	1,17	15	58	3
Peru	254.936	773,2	8.045	24,4	58.421	177,2	196.733	596,7	0,80	142	477	8
Chile	242.355	1.267,8	4.479	23,4	108.205	566,0	302.845	1.584,2	1,66	938	2.625	9
Iran	204.952	244,0	9.623	11,5	33.163	39,5	164.122	195,4	1,10	44	215	5
Pakistan	181.088	82,0	3.590	1,6	77.417	35,0	173.587	78,6	0,93	33	73	5
Mexico	180.545	140,0	21.825	16,9	63.442	49,2	920.187	713,7	1,09	54	778	6
Saudi Arabia	157.612	452,7	1.267	3,6	55.698	160,0	NA	NA	1,15	183	NA	8
Canada	101.326	268,5	8.430	22,3	5.638	14,9	49.211	130,4	0,90	13	117	3
Qatar	87.369	3.032,5	98	3,4	18.579	644,9	NA	NA	0,78	503	NA	9
Belarus	58.505	619,1	346	3,7	9.875	104,5	NA	NA	0,90	94	NA	7
Ecuador	50.640	287,0	4.223	23,9	7.520	42,6	73.246	415,2	1,05	45	437	5
Argentina	42.772	94,6	1.011	2,2	19.991	44,2	70.123	155,2	1,21	54	188	6

Scale											
Worst	Worst	Worst	Worst	Worst	Worst	Worst	Worst	Worst	2,0	100	1000
Best	Best	Best	Best	Best	Best	Best	Best	Best	0,0	0	0

Disclaimer: estimated active cases and estimated 14-day attack rate are assessed by assuming a lethality of 1 % (see report from 20 to 24 April, #37-41). This value can change in countries where suspicious deaths are reported as well (real values would be lower) and in countries where incidence among elderly people was minor (real values would be higher).

⁽¹⁾ ρ_7 is the average of 7 consecutive ρ , but can still fluctuate. ^(2,3) EPG stands for Effective Growth Potential. EPG_{REP} is the product of attack-rate of last 14 days per 10⁵ inhabitants by ρ_7 (empiric reproduction number). EPG_{EST} is the product of estimated real attack-rate of last 14 days per 10⁵ inhabitants and ρ_7 . Biocom-Cov degree is an epidemiological situation scale based on the level of last week's mean daily new cases (<https://upcommons.upc.edu/handle/2117/189661>, <https://upcommons.upc.edu/handle/2117/189808>).

Time indicators by country

These tables summarize a few time indicators for each country: time since 50 cases were reported, time interval between an attack rate of $1/10^5$ inhabitants and an attack rate of $10/10^5$ inhabitants, and time interval between attack rates of 10 to 100 per 10^5 inhabitants (only for countries that have overtaken this threshold).

EU+EFTA+UK countries

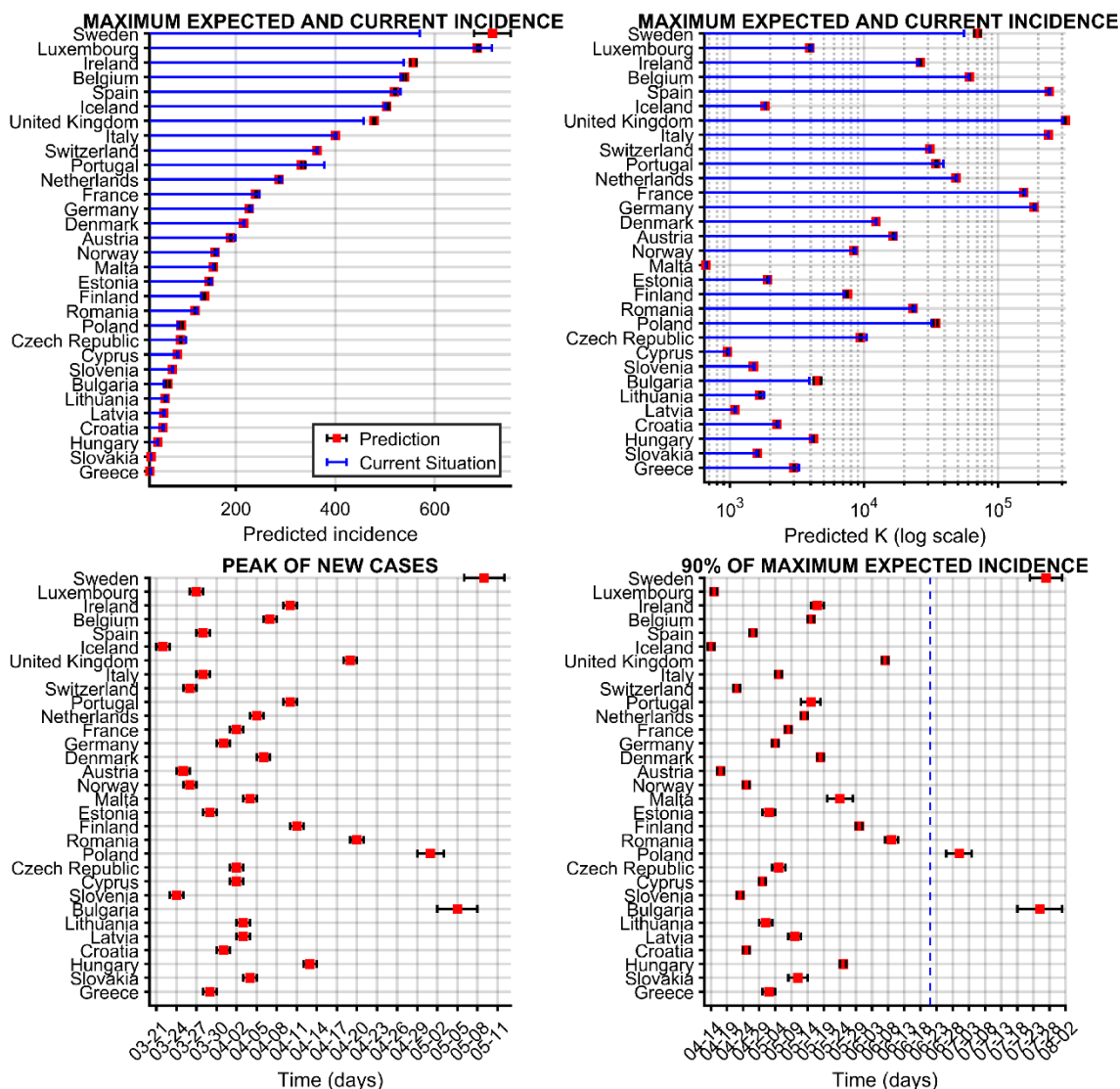
Countries	Days since the first 100 cases	Time interval between 1 and 10 cases / 10^5 inh. (days)	Time interval between 10 and 100 cases / 10^5 inh. (days)
Italy	120	11	16
Germany	114	12	17
France	113	10	20
Spain	113	8	12
United Kingdom	109	10	12
Belgium	108	11	14
Netherlands	108	11	20
Sweden	108	10	28
Norway	108	2	7
Switzerland	108	8	11
Austria	106	10	14
Denmark	105	4	30
Czech Republic	102	11	NA
Finland	102	12	46
Greece	102	18	NA
Iceland	102	5	15
Portugal	101	9	15
Slovenia	101	6	NA
Estonia	100	5	30
Ireland	100	8	18
Poland	100	17	NA
Romania	100	15	66
Luxembourg	97	6	7
Slovakia	96	24	NA
Bulgaria	95	30	NA
Croatia	95	12	NA
Hungary	94	20	NA
Latvia	94	12	NA
Lithuania	93	9	NA
Malta	92	9	35
Cyprus	91	12	NA

Other countries

Countries	Days since the first 100 cases	Time interval between 1 and 10 cases / 10^5 inh. (days)	Time interval between 10 and 100 cases / 10^5 inh. (days)
Iran	117	11	42
United States of America	112	8	15
Canada	103	11	27
Qatar	103	3	31
Brazil	100	20	34
Saudi Arabia	99	21	29
Chile	98	13	36
Pakistan	98	35	NA
India	98	38	NA
Russia	97	15	24
Peru	97	18	22
Ecuador	97	10	30
Mexico	96	25	47
Argentina	95	39	NA
Belarus	84	10	18

Long-term predictions

Evaluated with the **whole historical series**. Up-left: Predictions of maximum incidences per country **at the end of the first wave** (total final expected attack rate per 10^5 inh.). Up-right: Predictions of maximum absolute number of cases per country at the end of the first wave (K, in log scale). Blue lines indicate current situation. Bottom-left: Time in which peak in new cases was achieved / will be achieved. Bottom-right: Time at which 90 % of K was achieved / will be achieved. Blue dotted line indicates current date.



Final expected value for EU+EFTA+UK as a whole is not shown any more, since we are in the tail (see Analysis section in Report #87, <https://upcommons.upc.edu/handle/2117/190497>).

Situation and trends in Italian and Spanish regions

Italy

Country	Reported data								Indexes			
	Cumulative cases	Attack rate /10 ⁵ inh.	Cumulative deaths	Mortality /10 ⁵ inh.	Active cases (last 14 days)	14-day attack rate /10 ⁵ inh.	Estimated active cases (last 14 days)	Estimated 14-day attack rate /10 ⁵ inh.	$\rho_7^{(1)}$	EPG _{REP} ⁽²⁾	EPG _{EST} ⁽³⁾	Biocom-Cov degree
Lombardia	93,111	927.2	16,573	165.0	2,722	27.1	48,824	485.3	0.86	23	417	4
Piemonte	31,248	717.3	4,055	93.1	379	8.7	4,893	112.3	0.94	8	105	3
Emilia Romagna	28,243	633.3	4,235	95.0	315	7.1	4,739	106.3	1.15	8	123	2
Veneto	19,247	392.3	2,003	40.8	60	1.2	624	12.7	0.98	1	12	1
Toscana	10,211	273.8	1,099	29.5	67	1.8	747	20.0	0.68	1	14	1
Liguria	9,935	640.7	1,552	100.1	109	7.0	1,724	111.1	1.05	7	117	2
Lazio	8,025	136.5	830	14.1	197	3.4	2,034	34.6	0.70	2	24	2
Marche	6,774	444.1	994	65.2	27	1.8	405	26.5	1.01	2	27	2
Campania	4,624	79.7	431	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Puglia	4,527	112.4	540	13.4	15	0.4	183	4.5	2.76	1	13	1
Trento	4,464	416.3	466	43.5	28	2.6	288	53.6	1.66	4	89	2
Friuli Venezia Giulia	3,305	272.0	344	28.3	21	1.7	220	18.1	1.07	2	19	1
Abruzzo	3,282	250.2	460	35.1	17	1.3	244	18.6	0.59	1	11	1
Sicilia	3,072	61.4	280	5.6	NA	NA	NA	NA	NA	NA	NA	NA
Bolzano	2,633	2,450.8	292	271.8	29	27.0	330	63.4	NA	NA	NA	3
Umbria	1,438	163.0	78	8.8	6	0.7	NA	NA	0.75	1	NA	1
Sardegna	1,369	83.5	132	8.1	7	0.4	70	4.3	1.83	1	8	1
Valle d'Aosta	1,193	949.8	146	116.2	2	1.6	27	21.2	0.86	1	18	2
Calabria	1,174	60.3	97	5.0	15	0.8	NA	NA	2.71	2	NA	1
Molise	444	145.3	23	7.5	8	2.6	NA	NA	1.29	3	NA	2
Basilicata	401	71.2	27	4.8	2	0.4	NA	NA	NA	NA	NA	NA

Scale									
Worst	Worst	Worst	Worst	Worst	Worst	Worst	Worst	2.0	100
Best	Best	Best	Best	Best	Best	Best	Best	0.0	0

Spain

Data from 15th June, series built with the day of symptoms' onset

Autonomous regions	Reported data				Indexes	
	Cumulative cases	Attack rate /10 ⁵ inh.	Active cases (last 14 days)	14-day attack rate /10 ⁵ inh.	$\rho_7^{(1)}$	EPG _{REP} ⁽²⁾
Madrid	70,995	1,069.1	939	14.1	0.97	14
Catalunya	55,437	732.8	1,137	15.0	0.84	13
Castilla y Leon	26,448	1,098.3	262	10.9	1.04	11
Castilla-La Mancha	22,103	1,085.9	232	11.4	1.00	11
Andalucia	16,514	196.0	83	1.0	1.59	2
Comunitat Valenciana	14,747	296.5	100	2.0	0.84	2
Euskadi	14,498	665.6	169	7.8	0.78	6
Galicia	10,707	396.5	26	1.0	1.03	1
Navarra	7,808	1,201.3	38	5.8	1.49	9
Aragon	6,474	490.2	129	9.8	1.7	16
Extremadura	5,634	528.8	43	4.0	0.82	3
La Rioja	3,990	1,272.4	14	4.5	0.61	3
Canarias	2,486	112.6	46	2.1	2.50	5
Asturias	2,435	238.2	7	0.7	0.29	0
Murcia	2,434	163.6	19	1.3	1.56	2
Cantabria	2,333	401.1	26	4.5	1.39	6
Baleares	2,308	194.3	52	4	1.3	6
Ceuta	222	261.7	2	2.4	NA	NA
Melilla	137	161.7	1	1.2	NA	NA

Scale					
Worst	Worst	Worst	Worst	2.0	200
Best	Best	Best	Best	0.0	0

Disclaimer: estimated active cases and estimated 14-day attack rate are assessed by assuming a lethality of 1 % (see report from 20 to 24 April, #37-41). This value can change in countries where suspicious deaths are reported as well (real values would be lower) and in countries where incidence among elderly people was minor (real values would be higher).

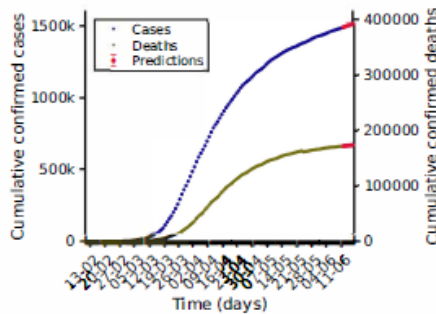
⁽¹⁾ ρ_7 is the average of 7 consecutive ρ , but can still fluctuate. ^(2,3) EPG stands for Effective Growth Potential. EPG_{REP} is the product of attack-rate of last 14 days per 10⁵ inhabitants by ρ_7 (empiric reproduction number). EPG_{EST} is the product of estimated real attack-rate of last 14 days per 10⁵ inhabitants and ρ_7 . Biocom-Cov degree is an epidemiological situation scale based on the level of last week's mean daily new cases (<https://upcommons.upc.edu/handle/2117/189661>, <https://upcommons.upc.edu/handle/2117/189808>).

Long-term predictions are not shown any more, since all Italian and Spanish regions are already in the tail (see Analysis section in Report #87, <https://upcommons.upc.edu/handle/2117/190497>).

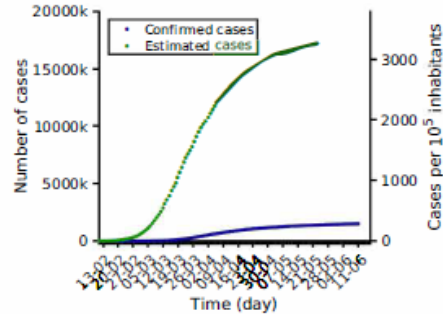
Legend: Countries' reports details

EU+EFTA+UK 11-06-2020. Population: 527.9M. Current cum. incidence: 283/10⁵

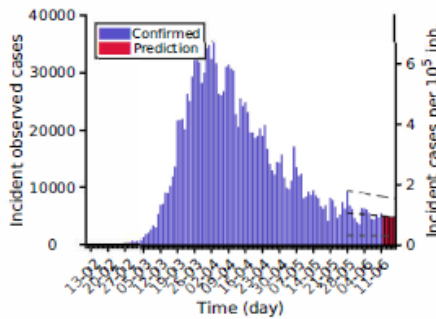
Reported cumulative cases (blue) and deaths (brown), together with predictions (red)



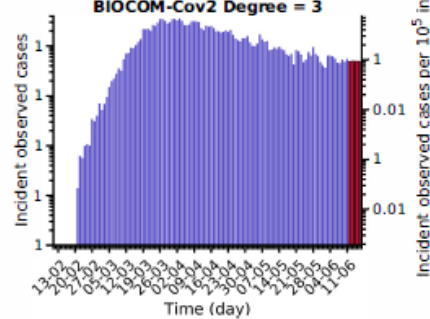
Estimated and reported cases.



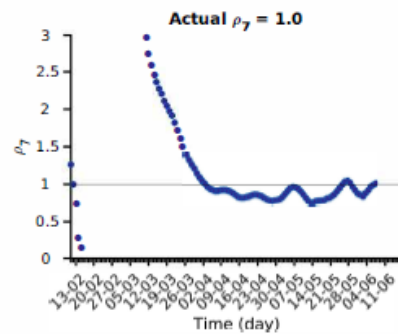
Incident observed cases and predictions.



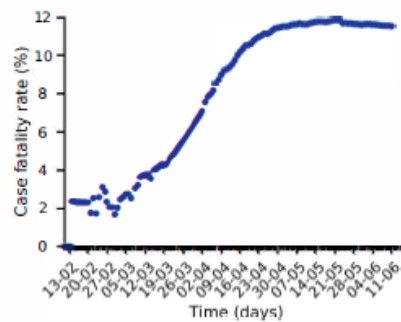
Incident observed cases in a logarithmic scale, with Biocom-Cov degree.



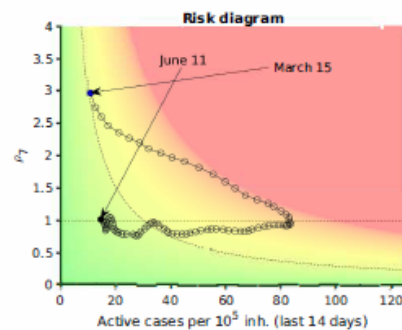
Evolution of empiric reproductive number ρ_T



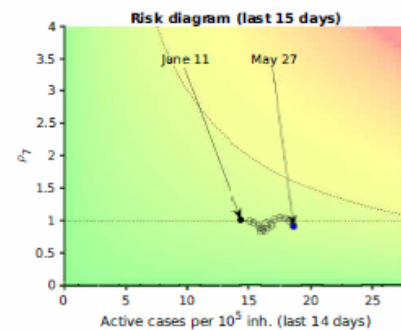
Case fatality rate



Risk diagram

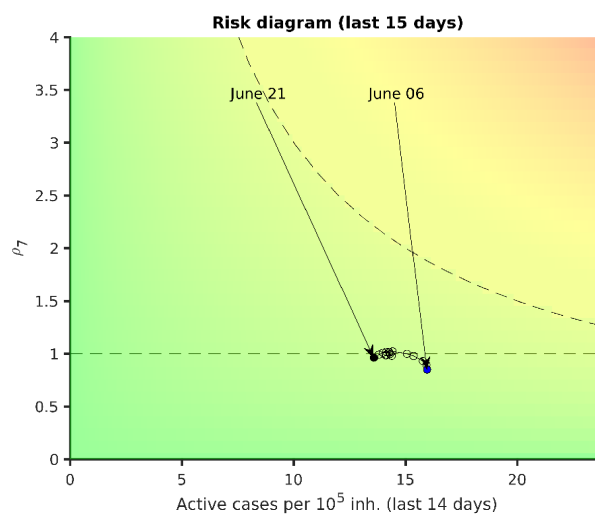
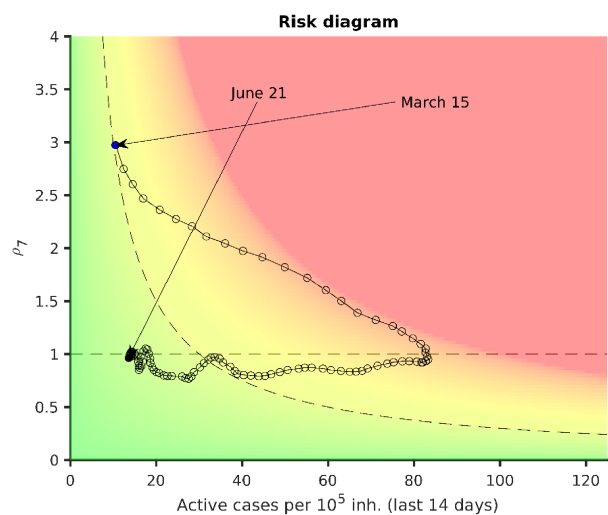
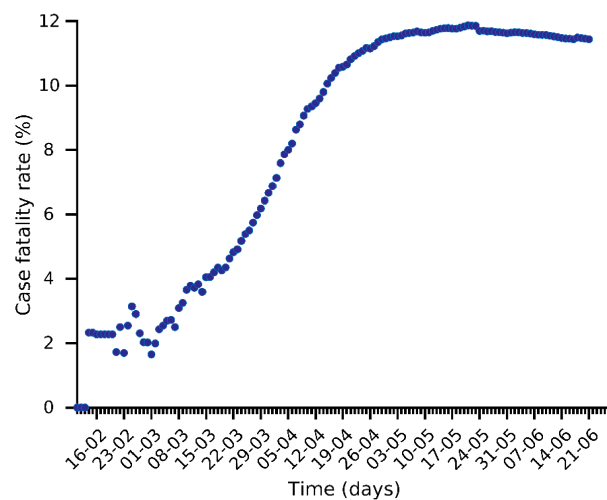
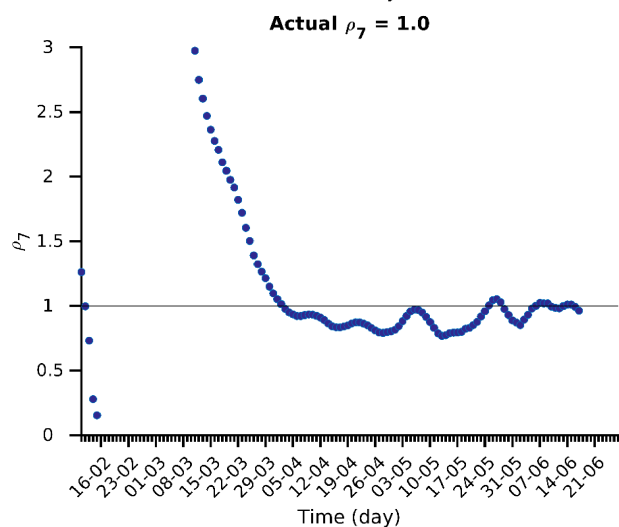
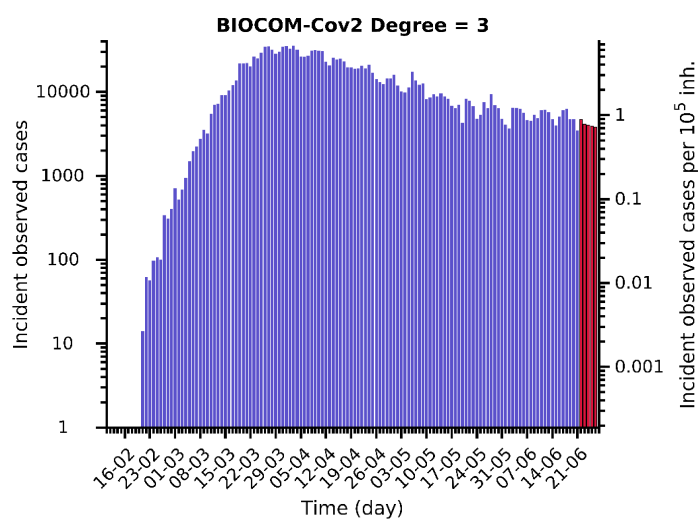
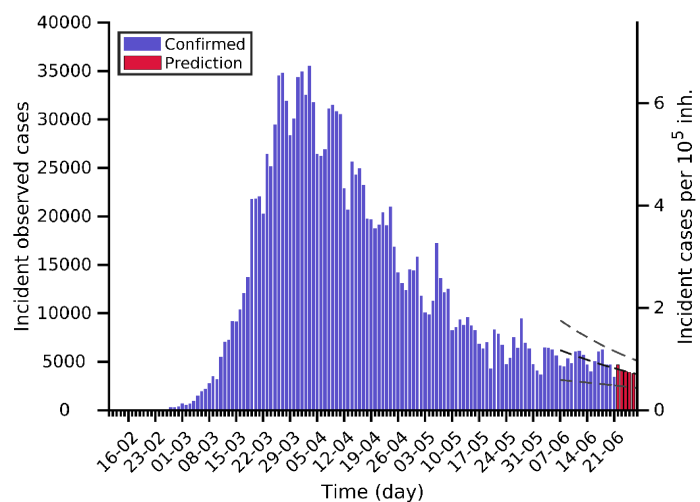
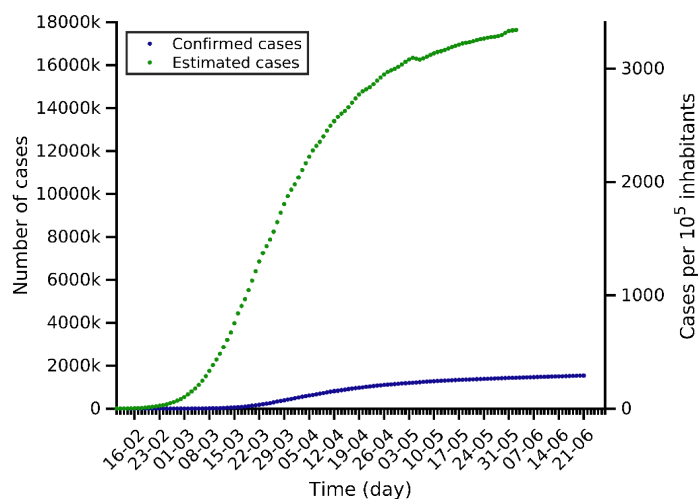
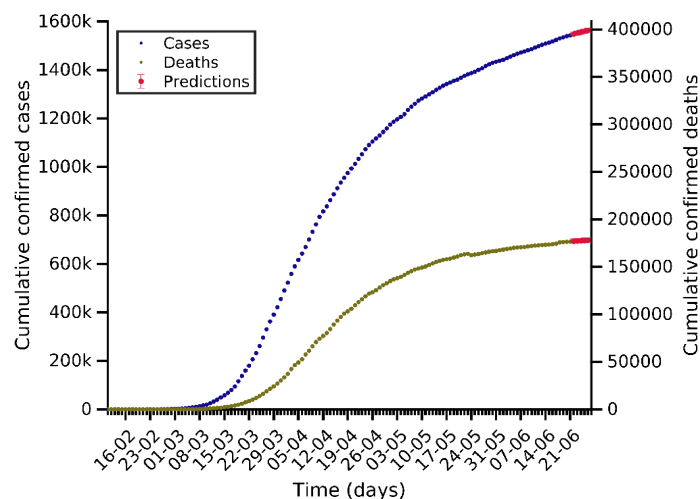


Risk diagram of last 15 days

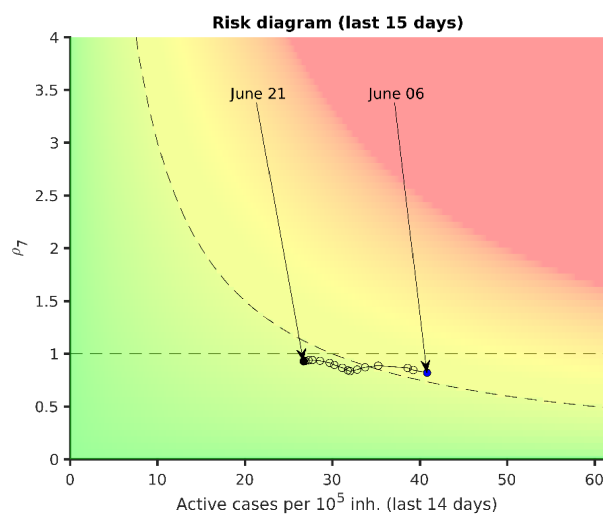
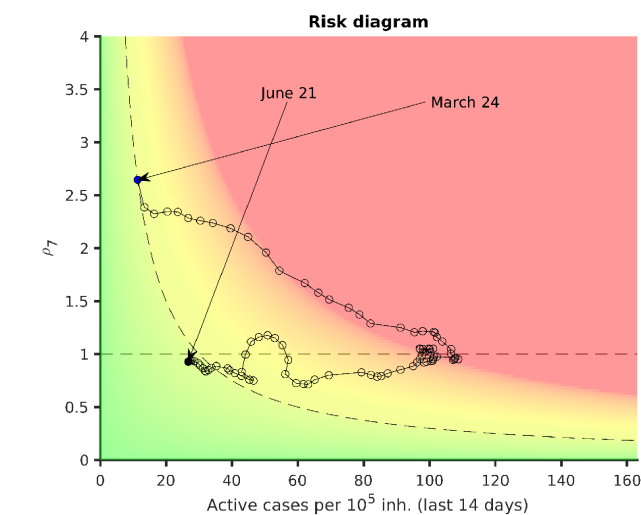
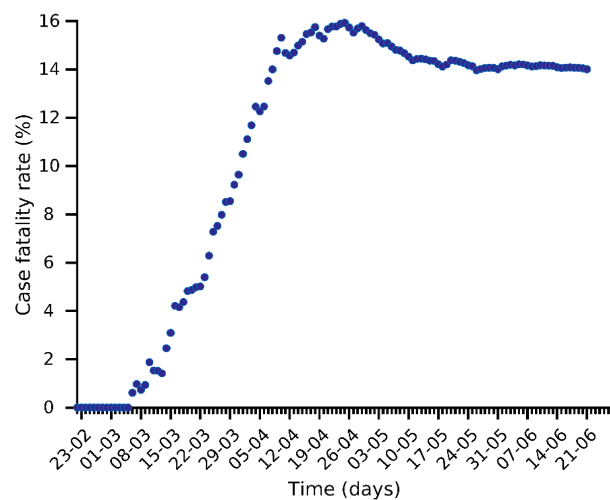
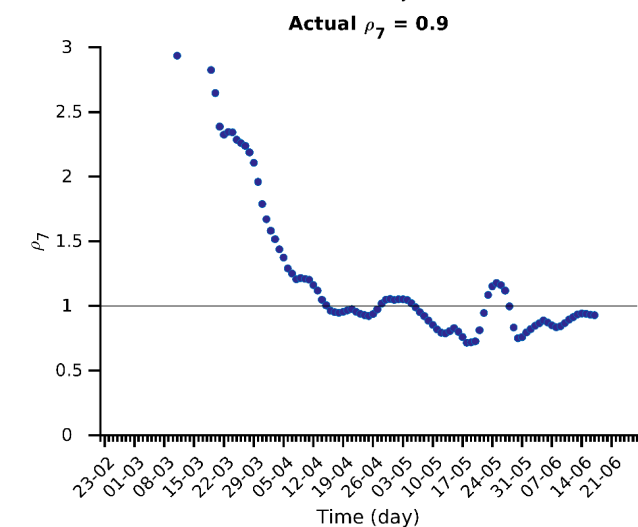
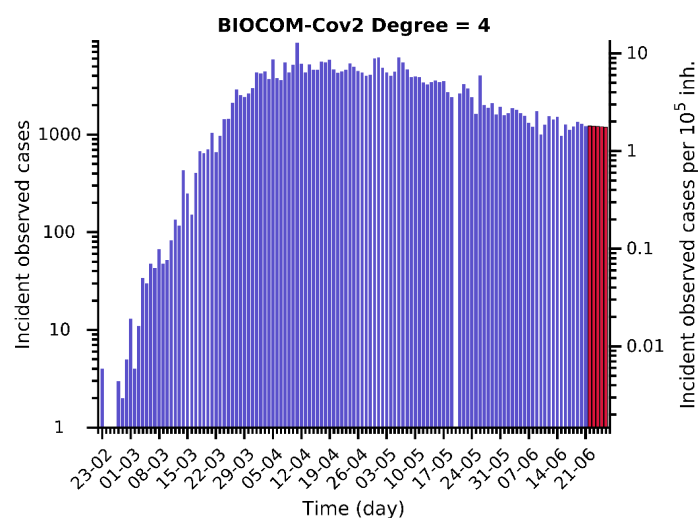
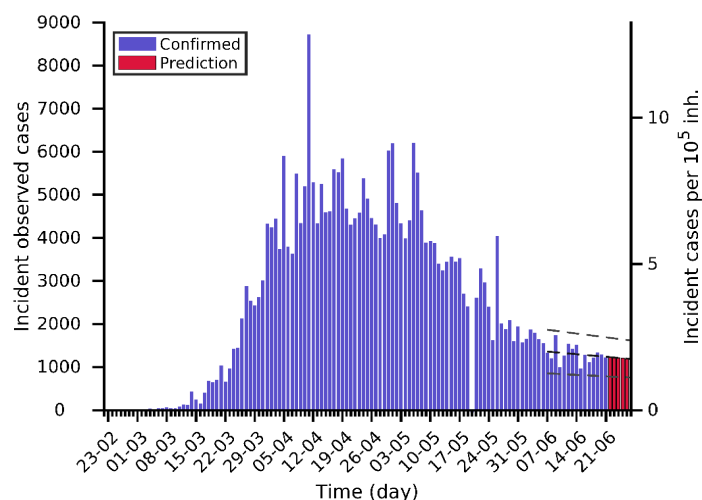
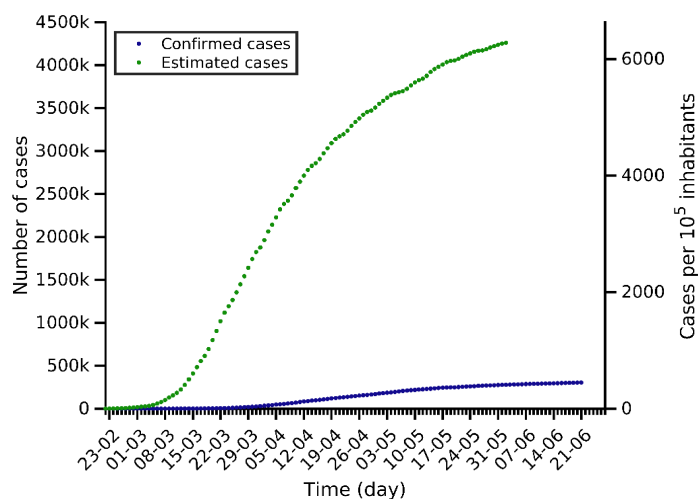
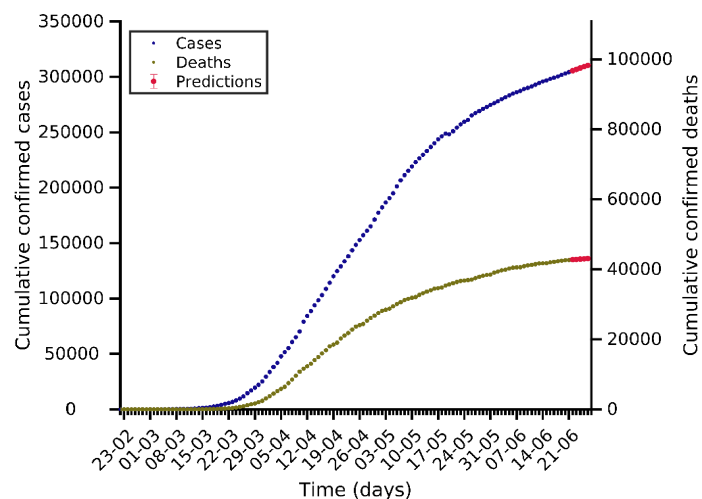


(1) Analysis and prediction of COVID-19 for EU+EFTA+UK

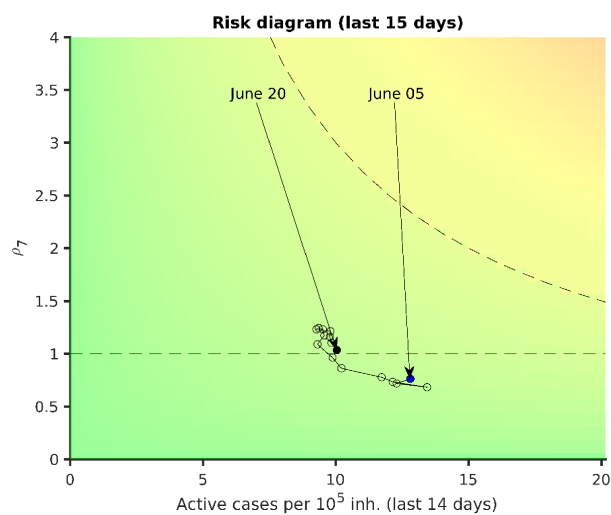
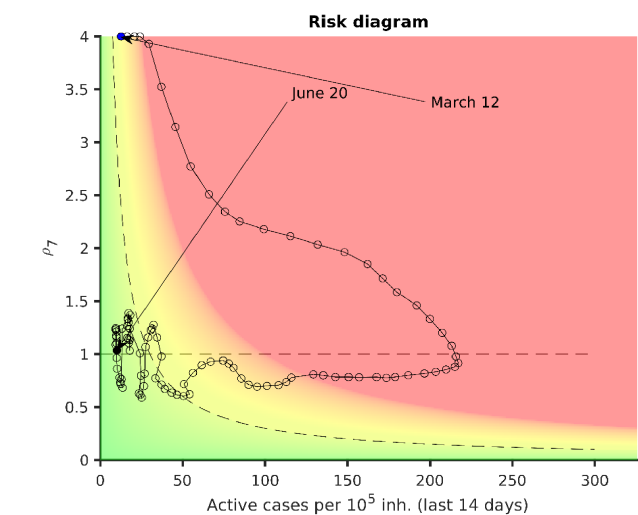
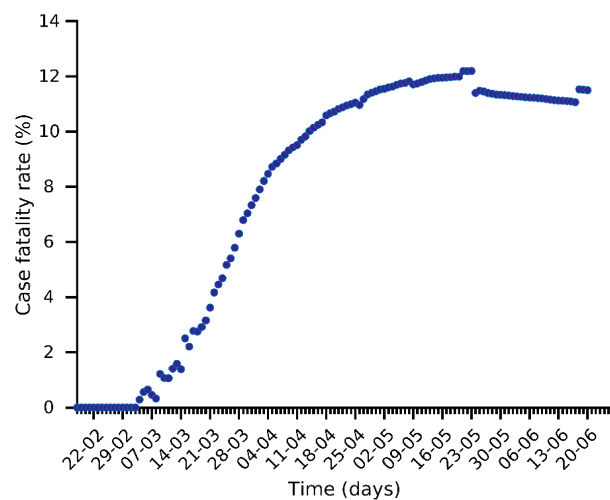
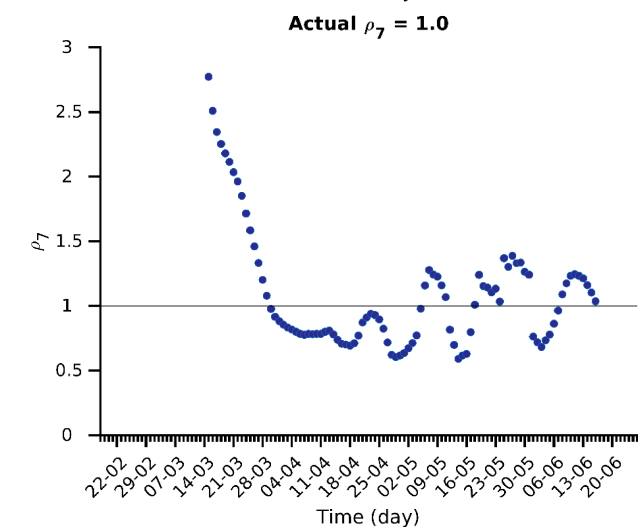
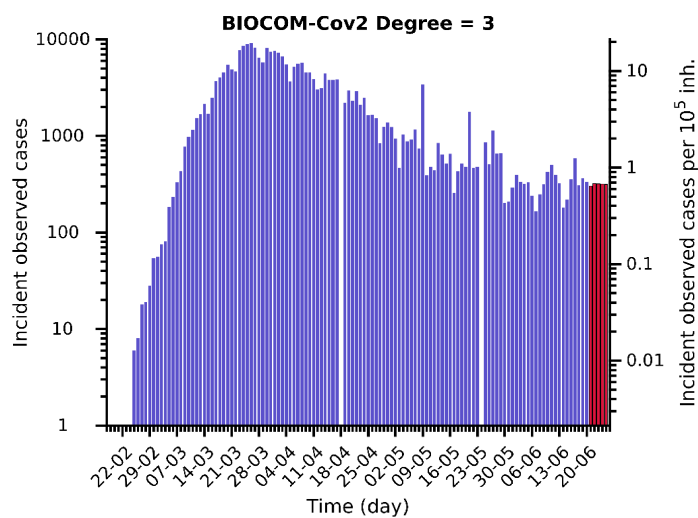
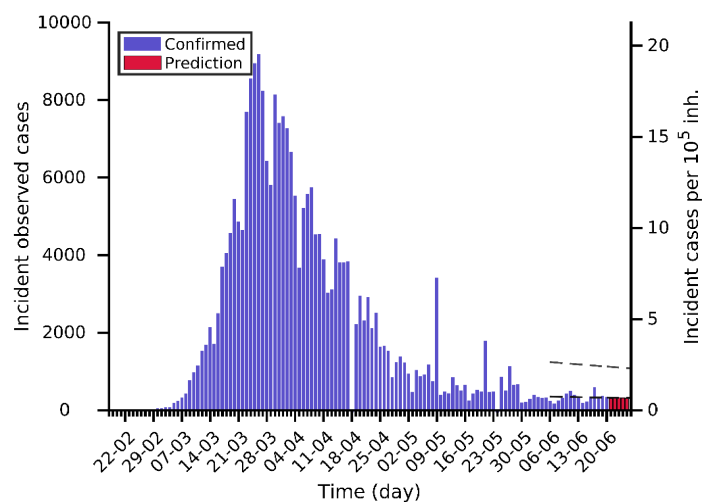
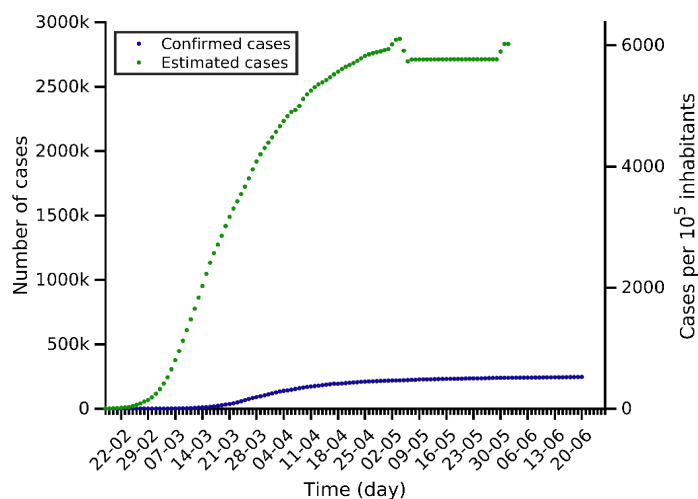
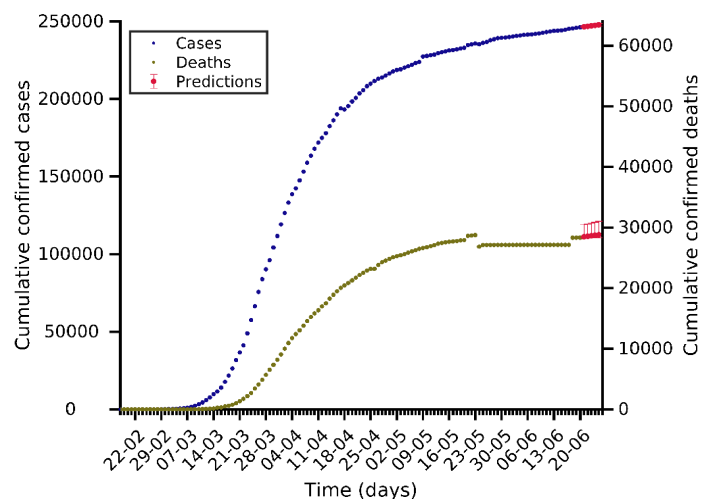
Data obtained from <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>



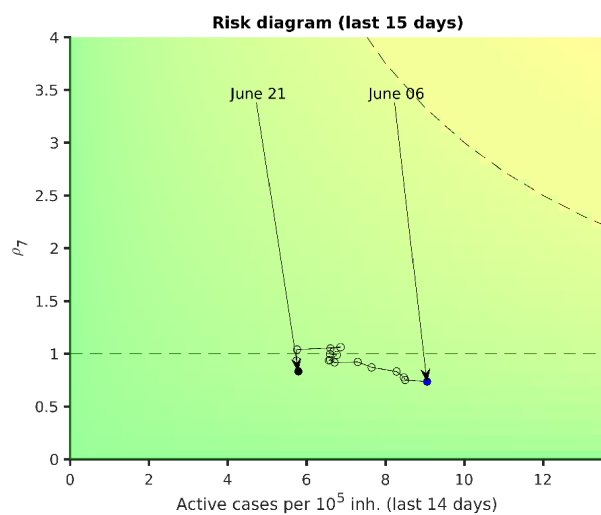
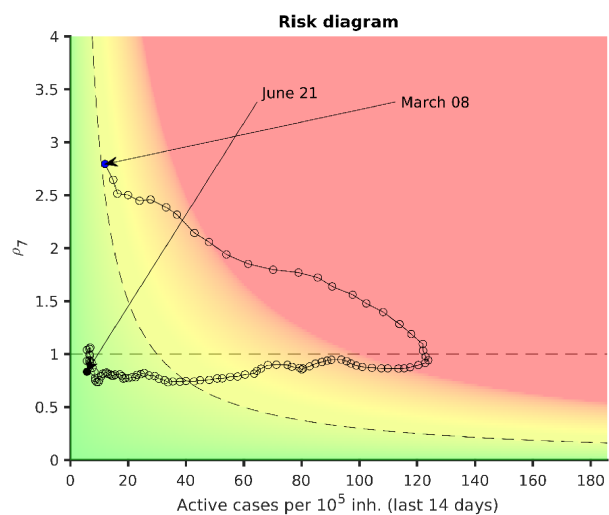
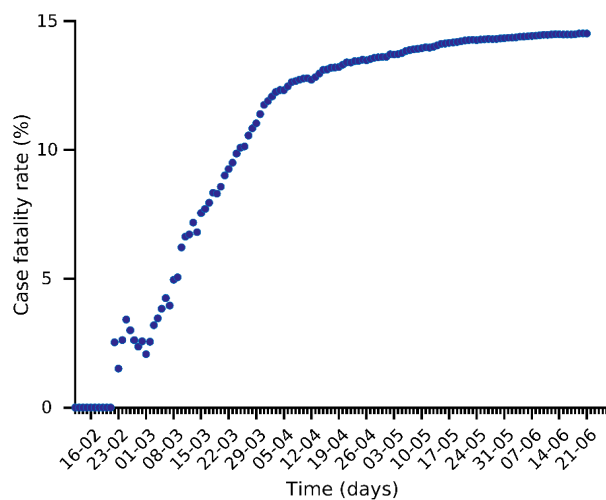
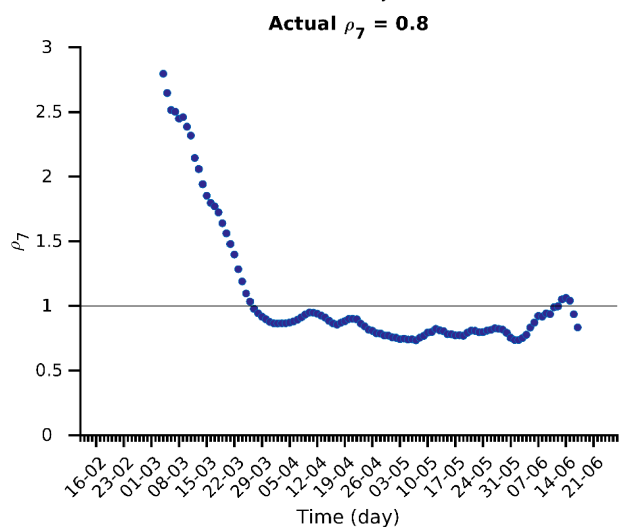
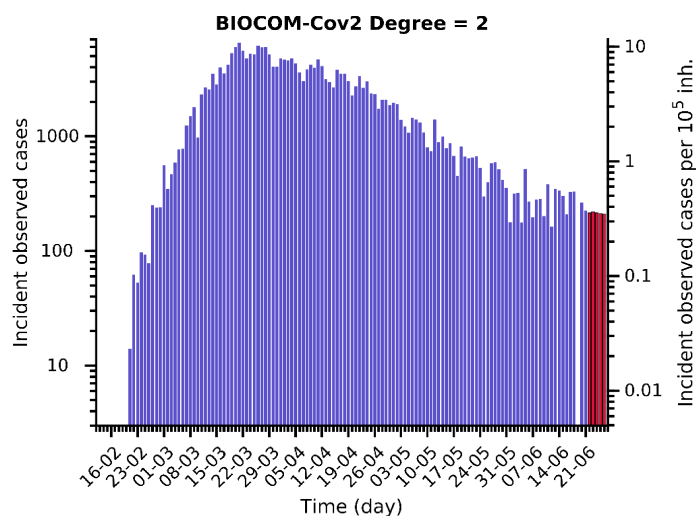
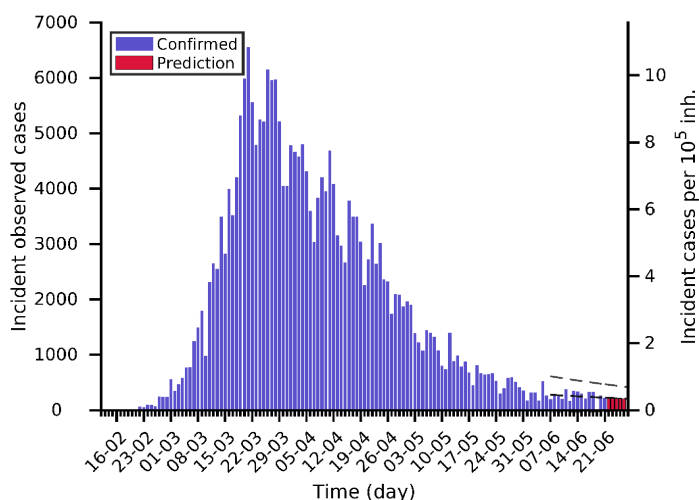
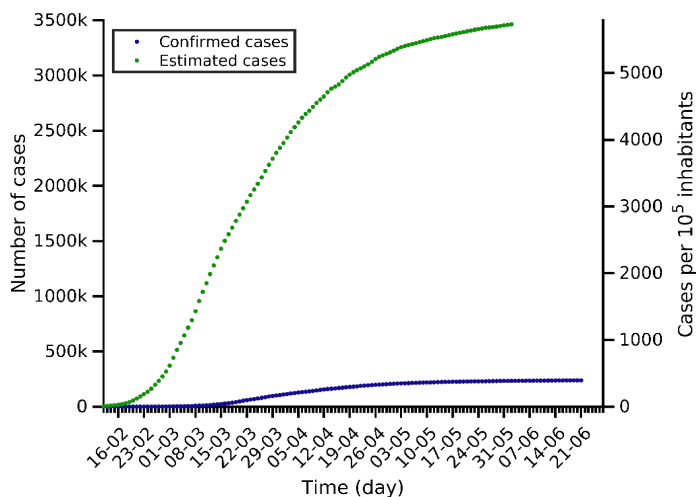
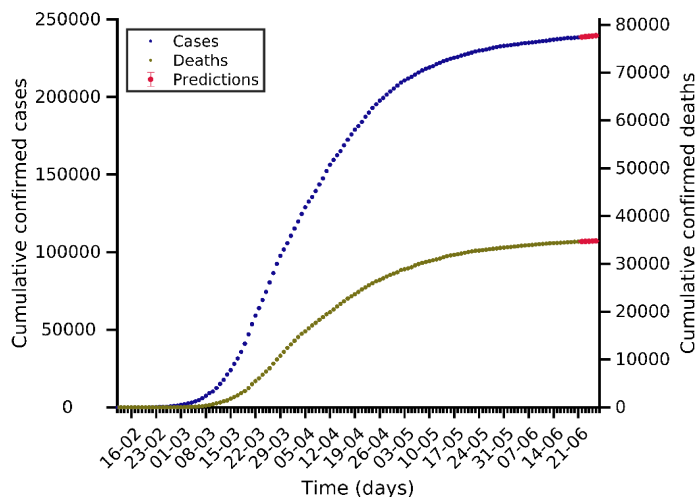
UK 21-06-2020. Population: 67.9M. Current cumulative incidence: 448/10⁵



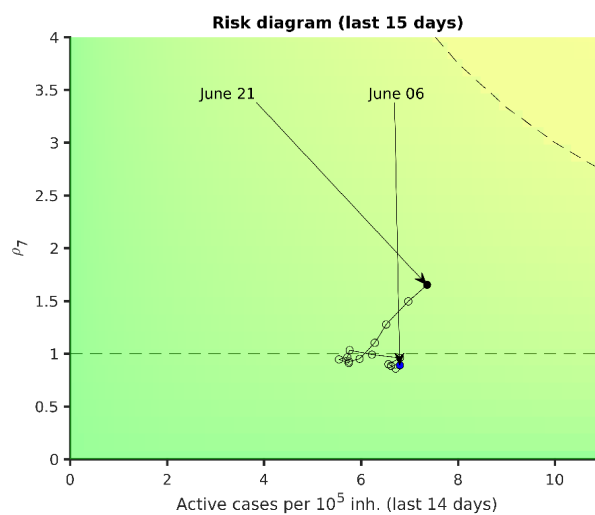
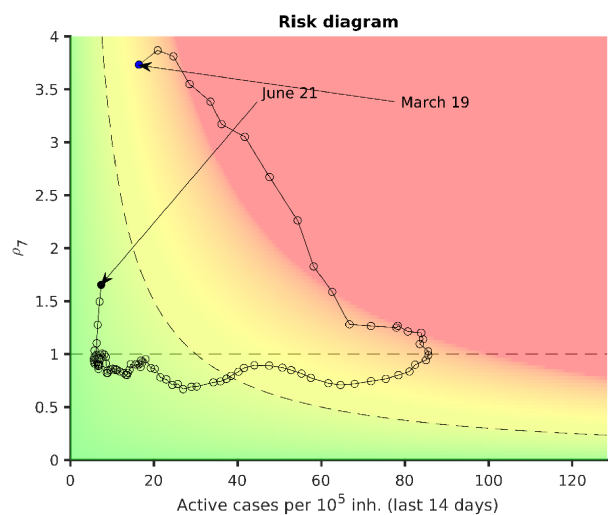
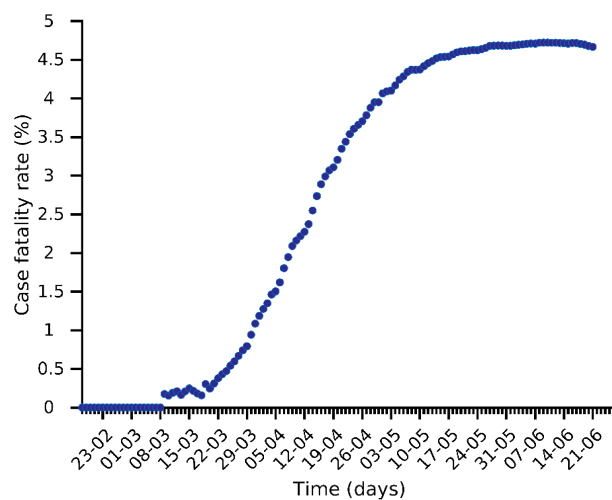
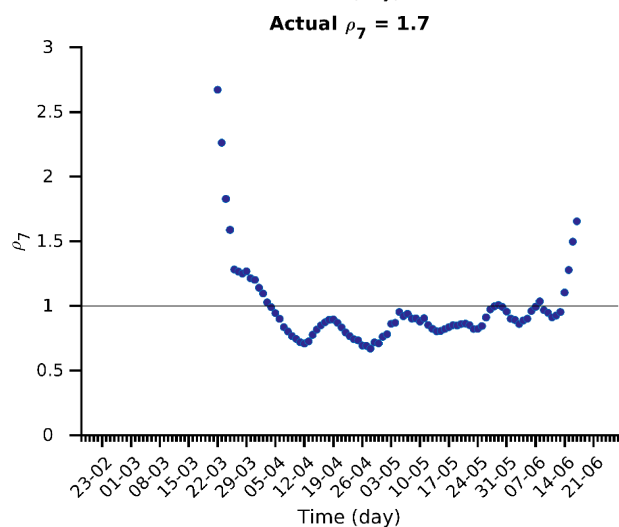
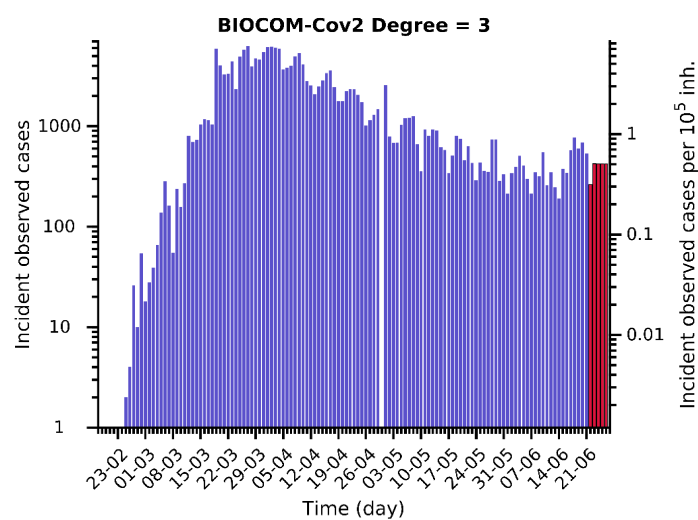
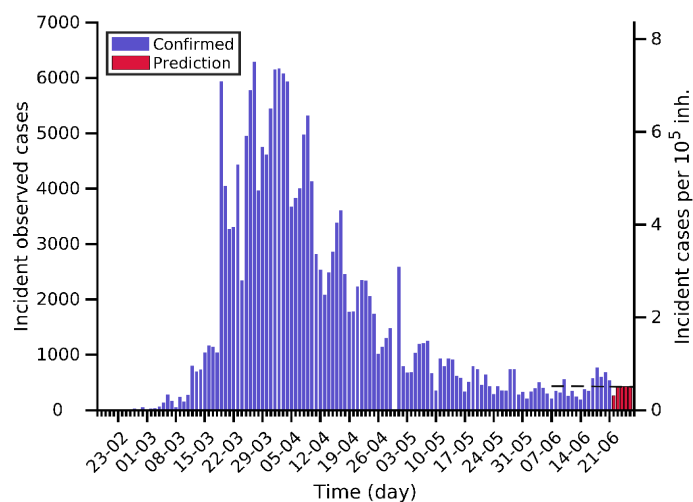
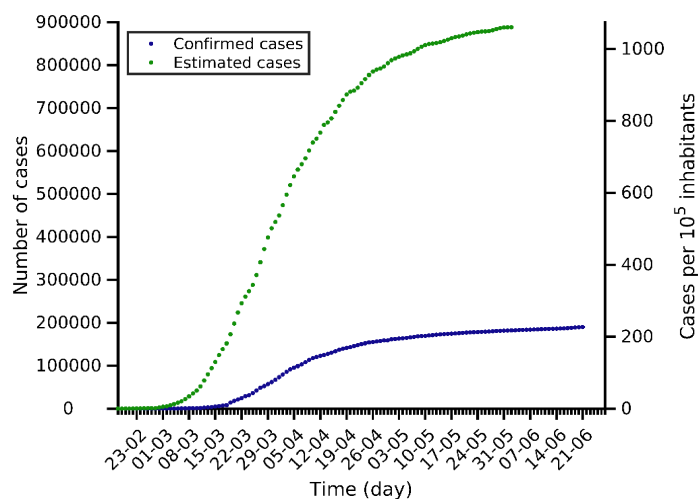
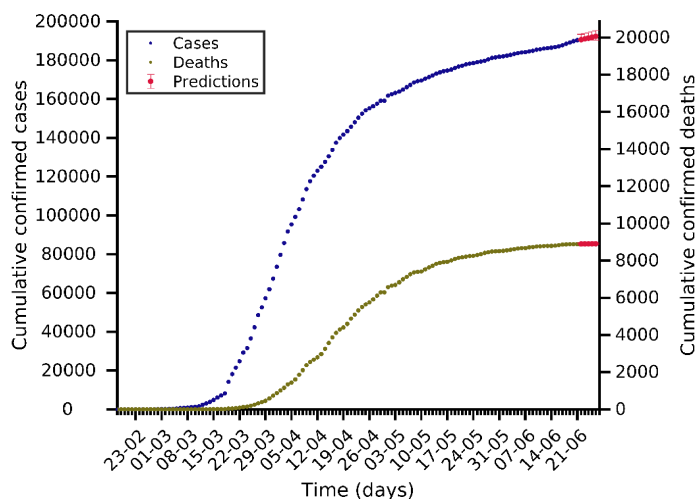
Spain 20-06-2020. Population: 47.0M. Current cumulative incidence: 524/10⁵



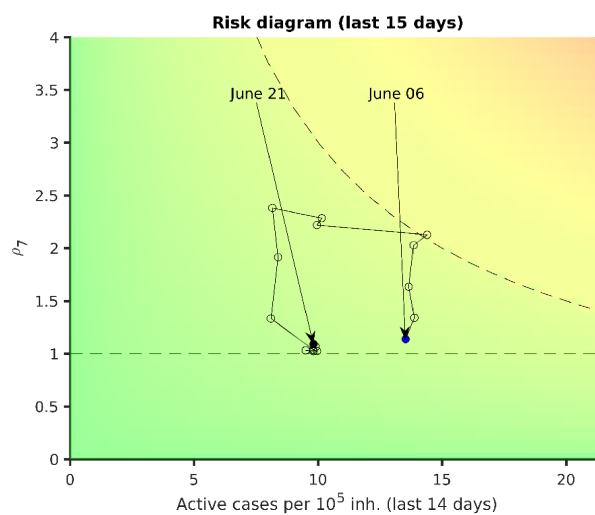
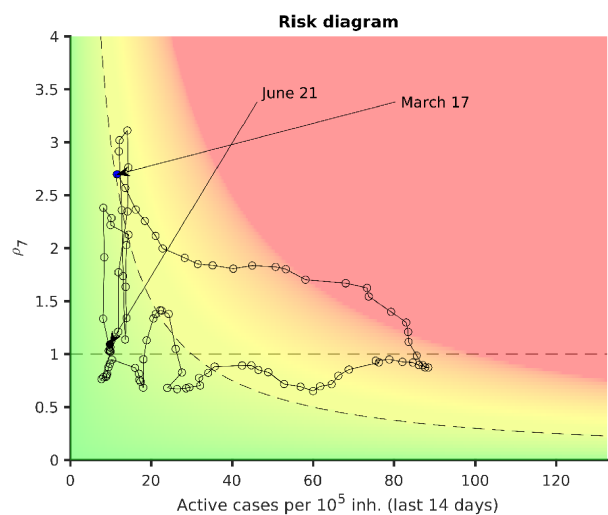
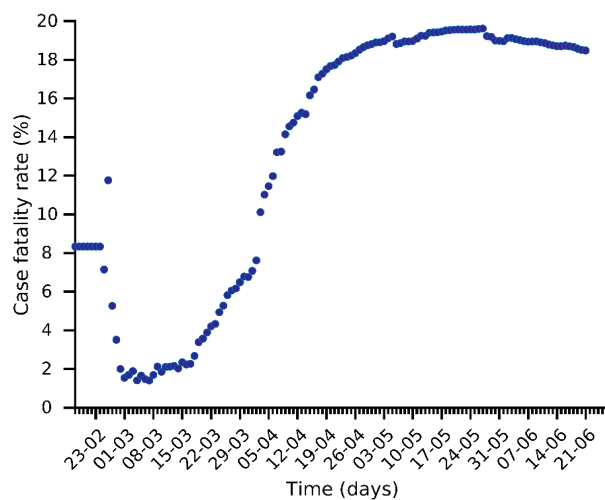
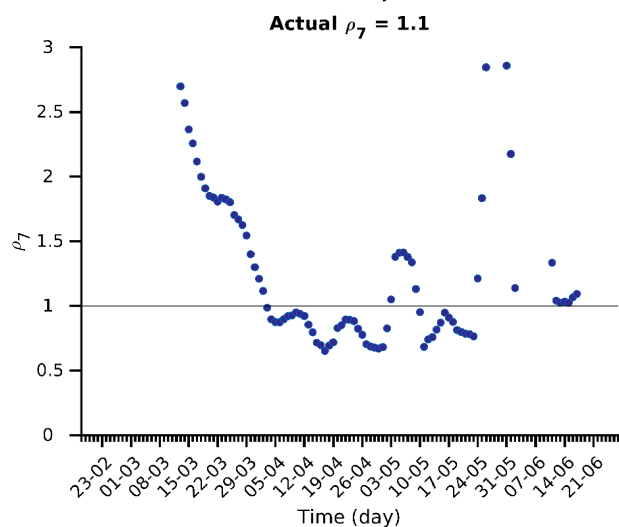
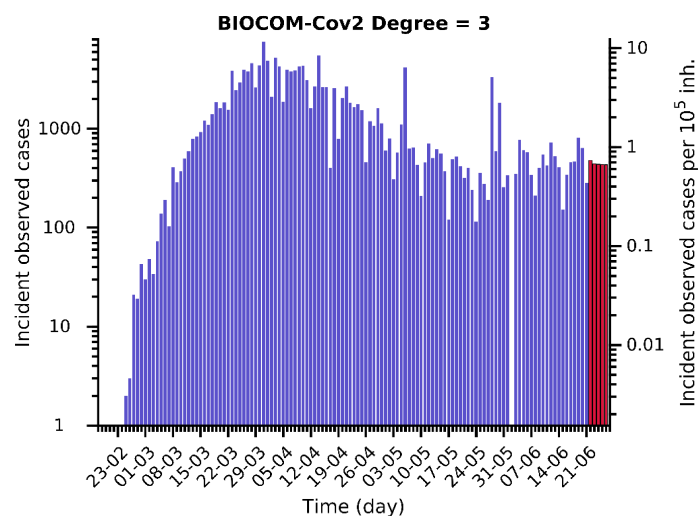
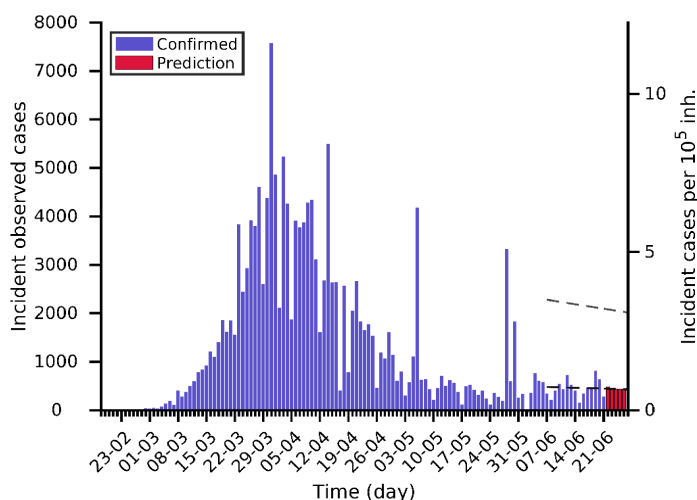
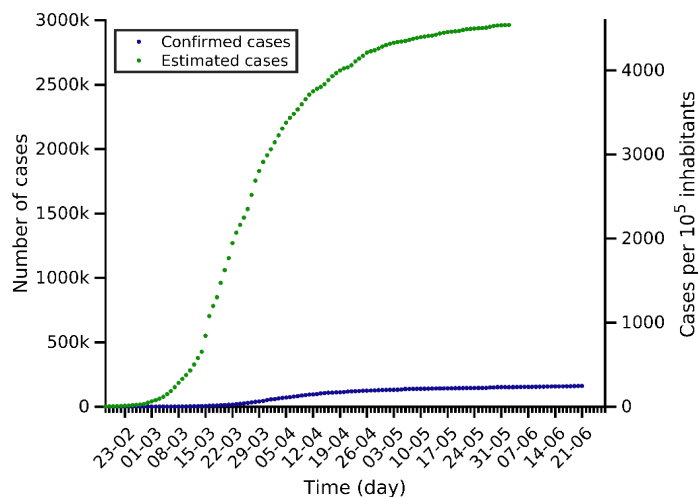
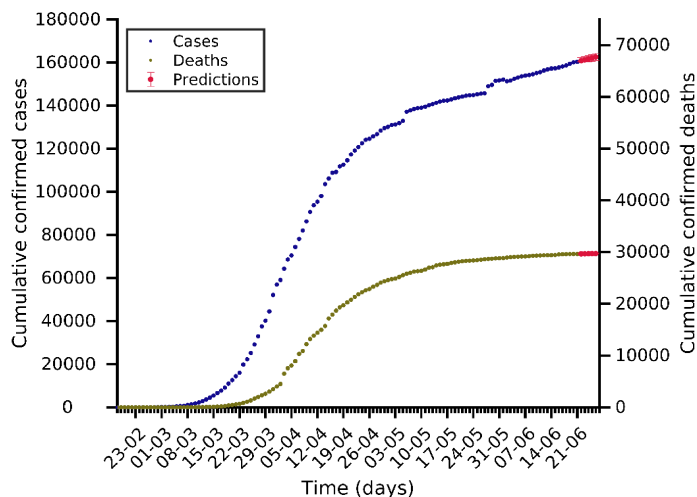
Italy 21-06-2020. Population: 60.5M. Current cumulative incidence: 394/10⁵



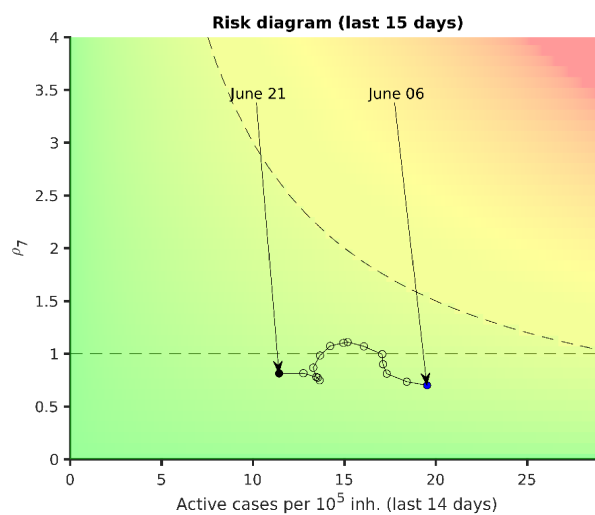
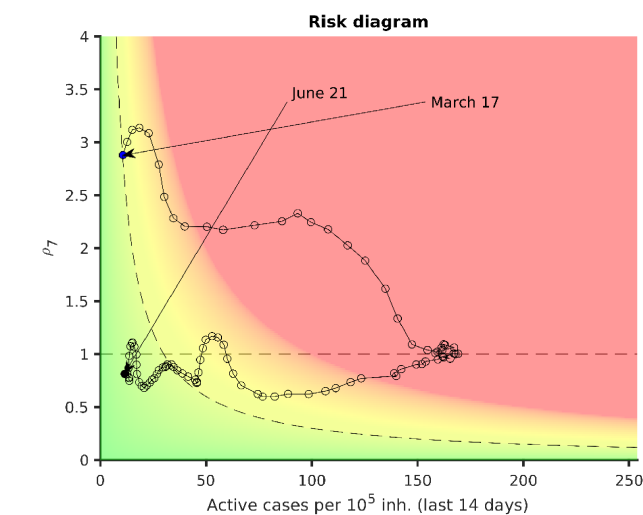
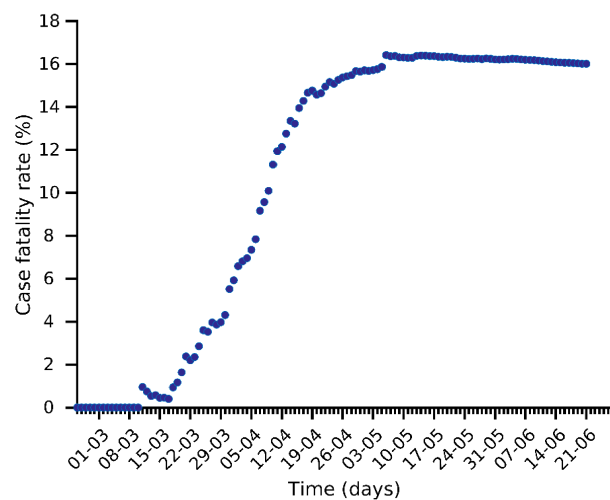
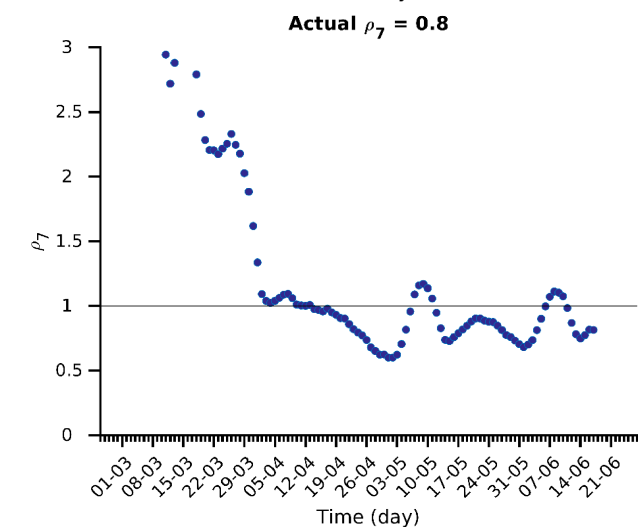
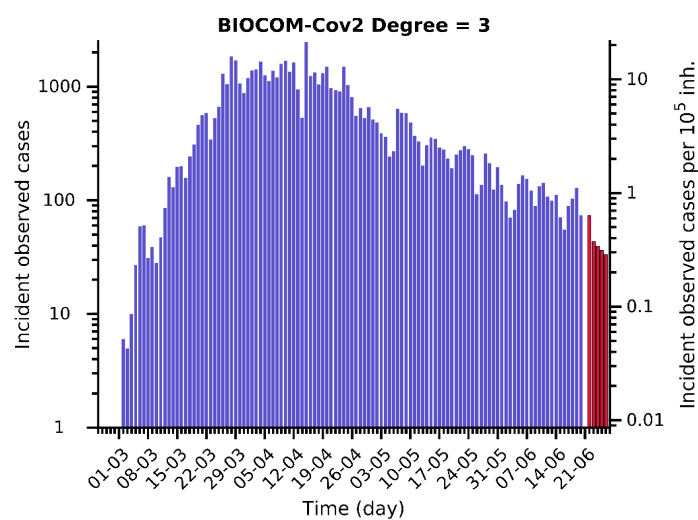
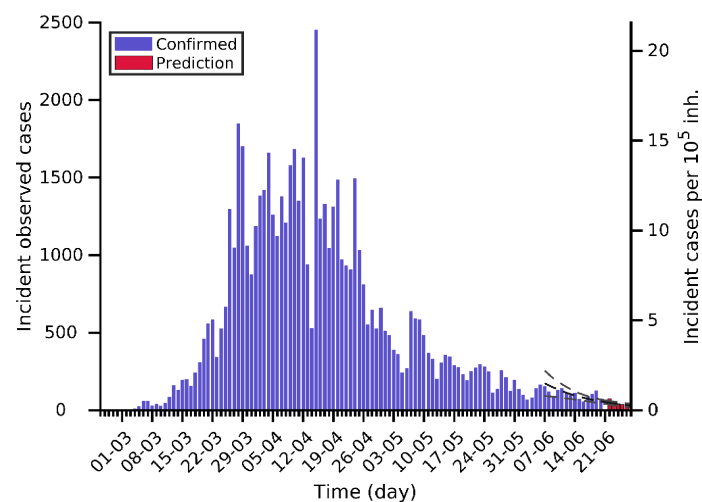
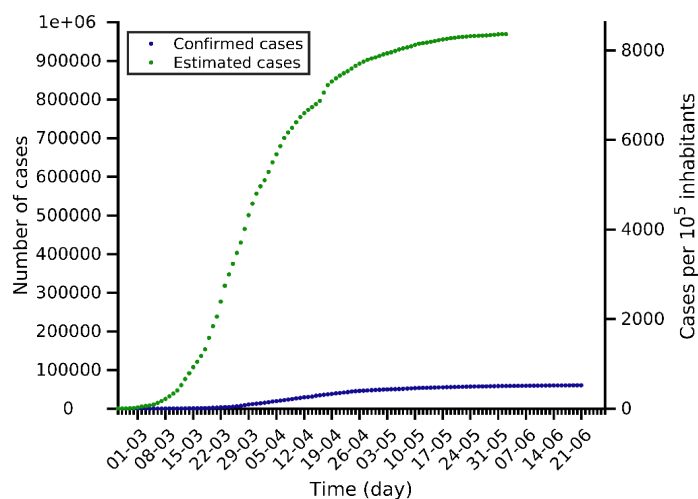
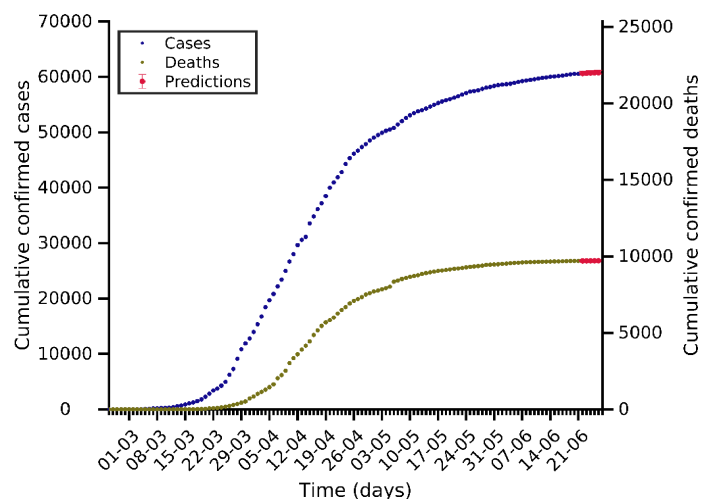
Germany 21-06-2020. Population: 83.8M. Current cumulative incidence: 227/10⁵



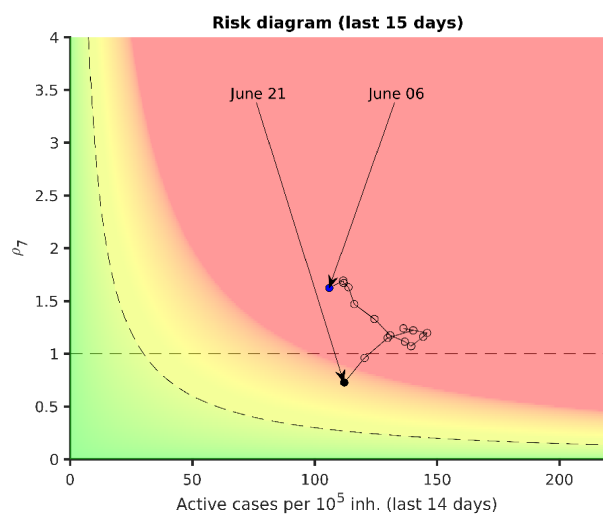
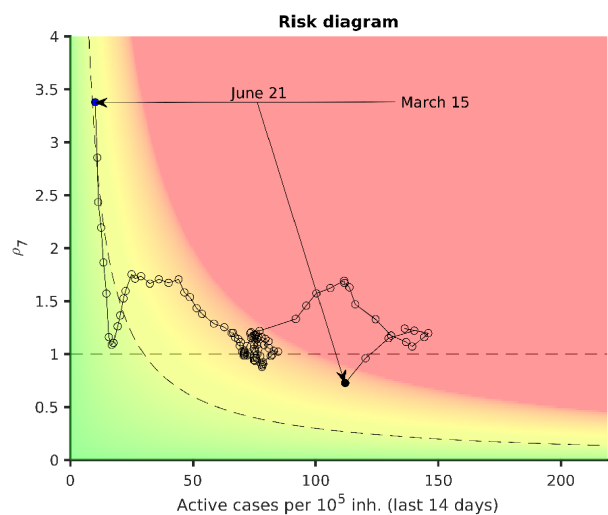
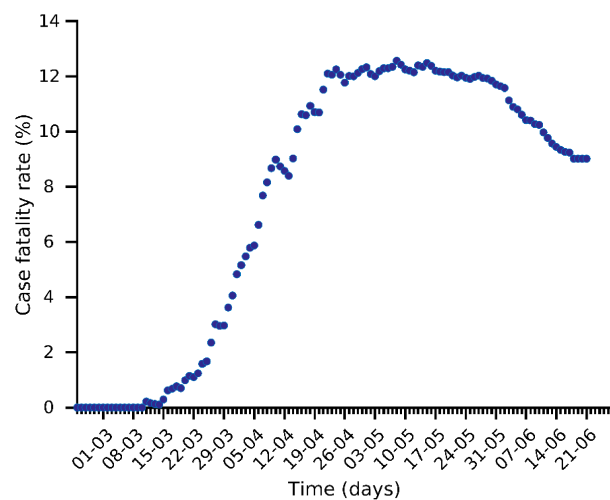
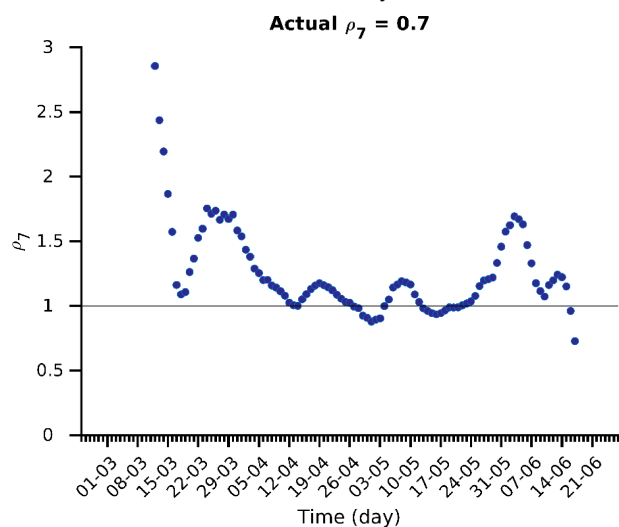
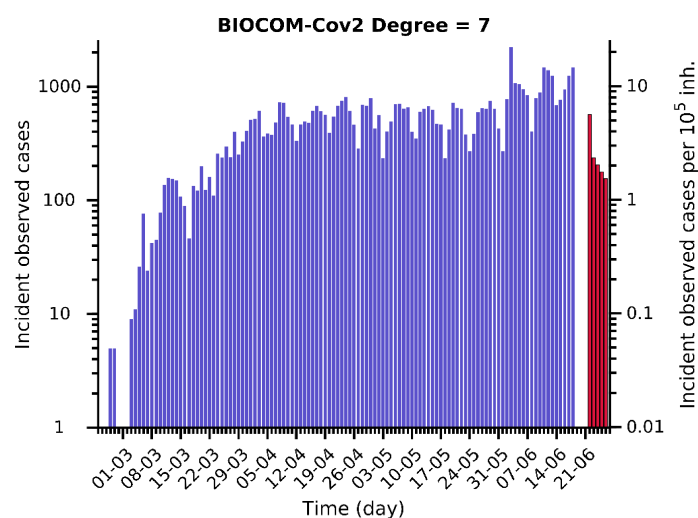
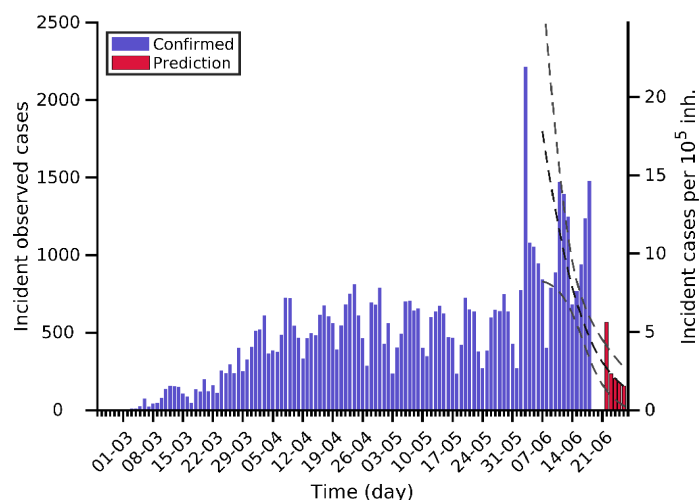
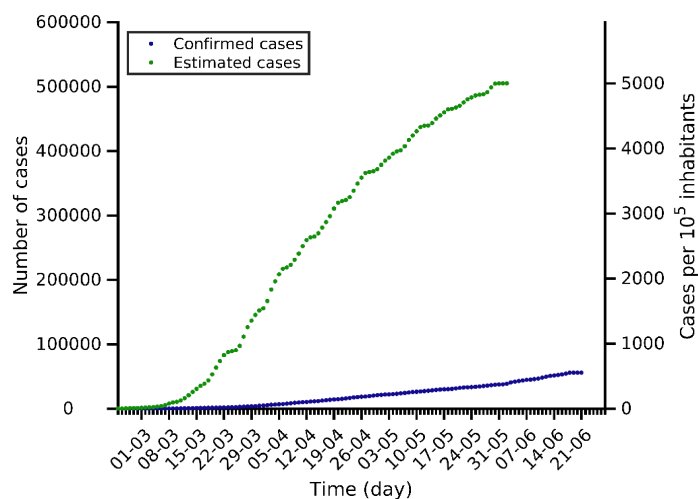
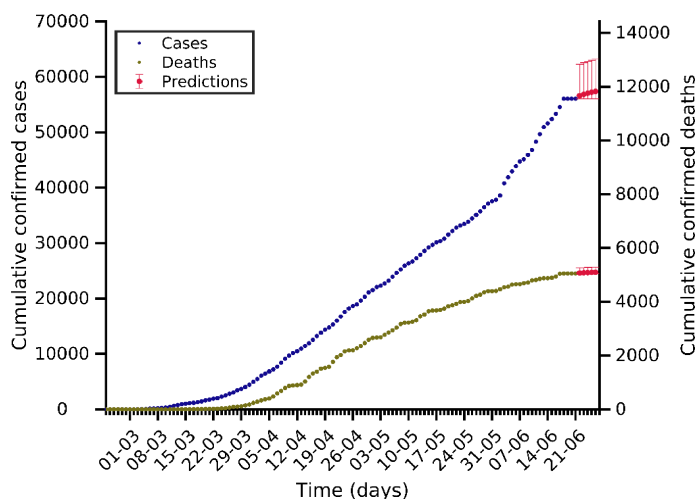
France 21-06-2020. Population: 65.3M. Current cumulative incidence: 246/10⁵

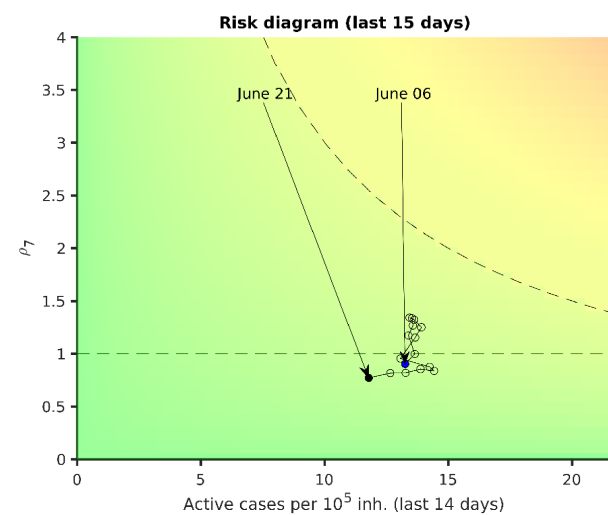
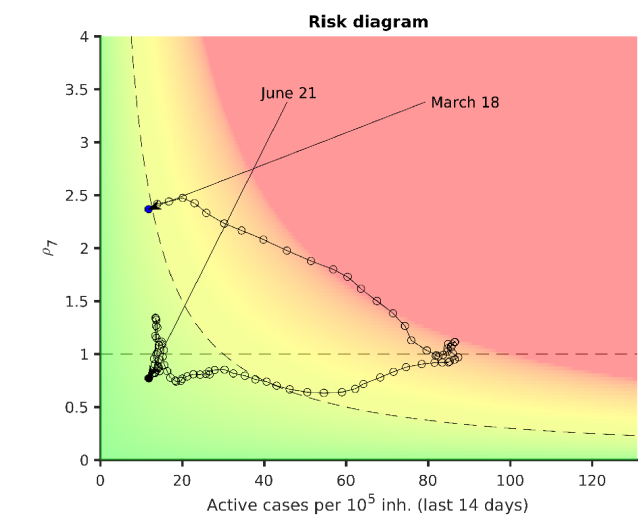
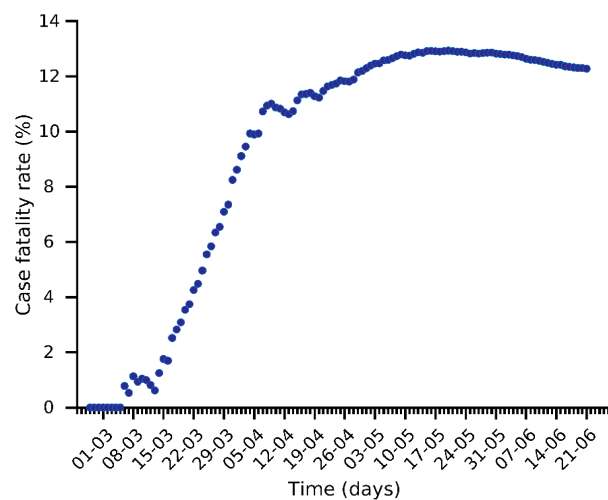
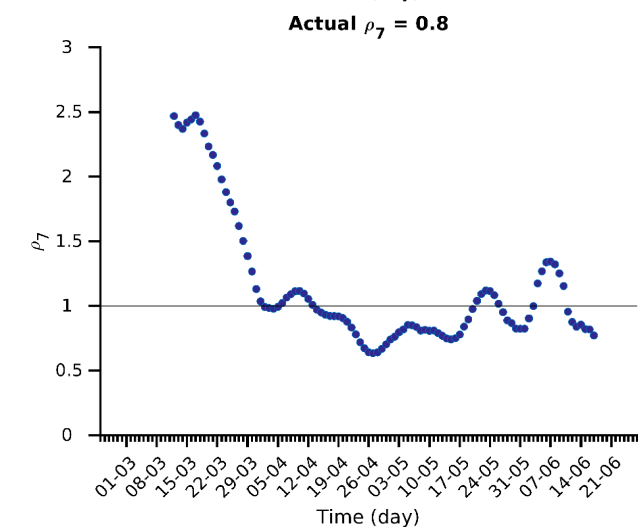
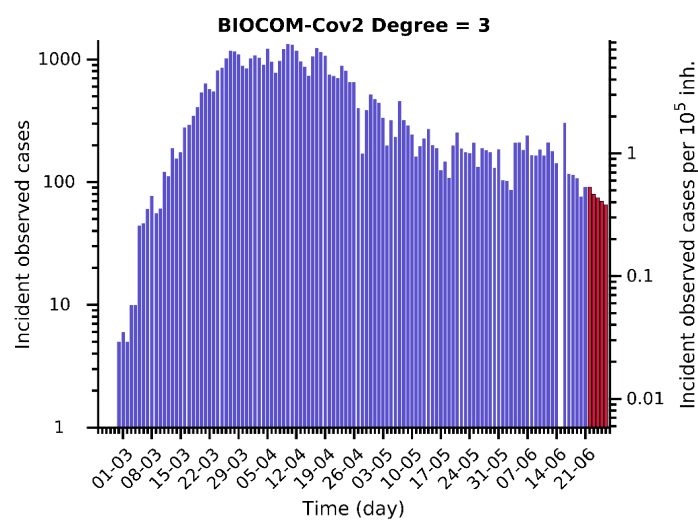
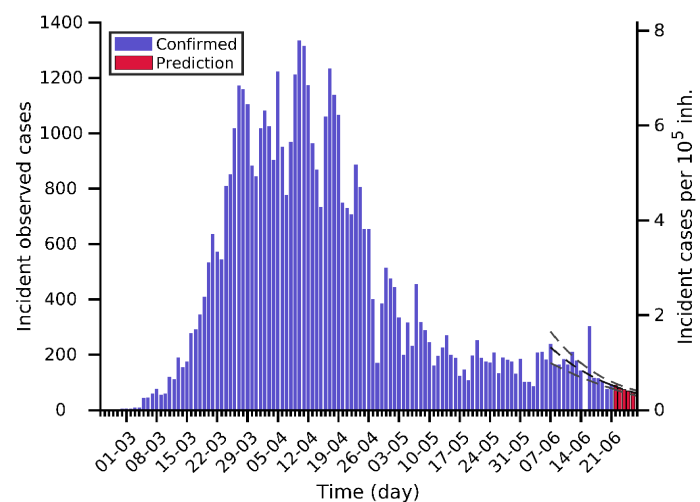
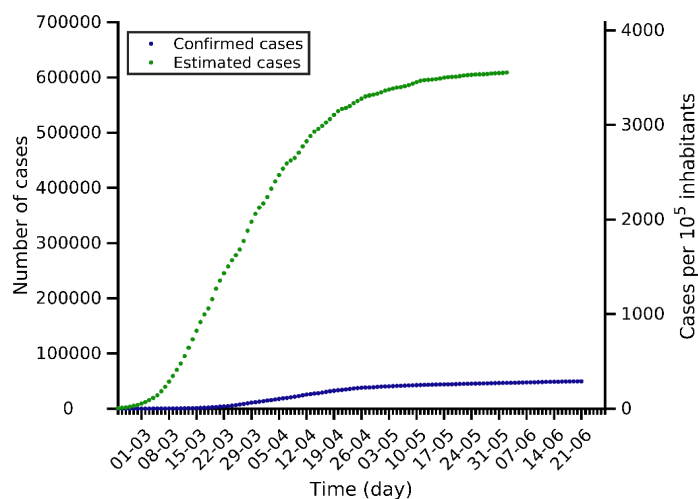
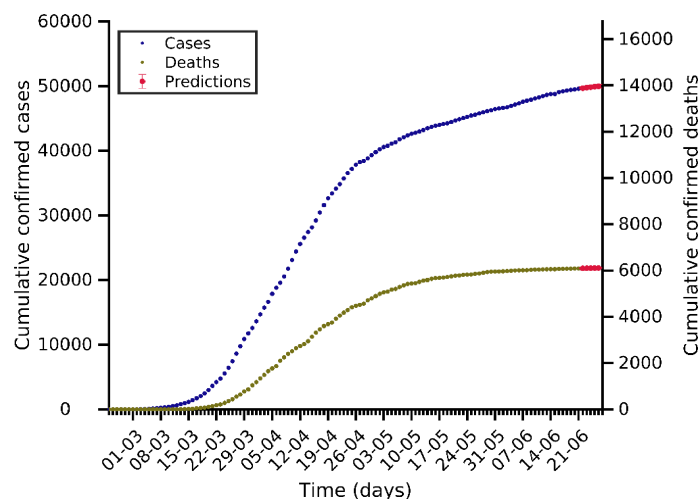


Belgium 21-06-2020. Population: 11.6M. Current cumulative incidence: 522/10⁵

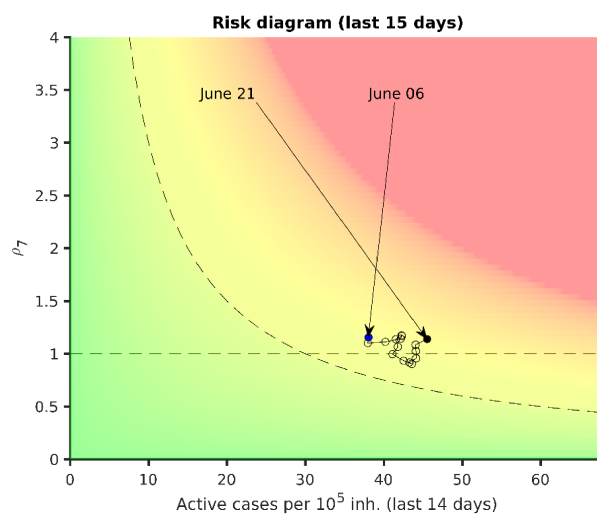
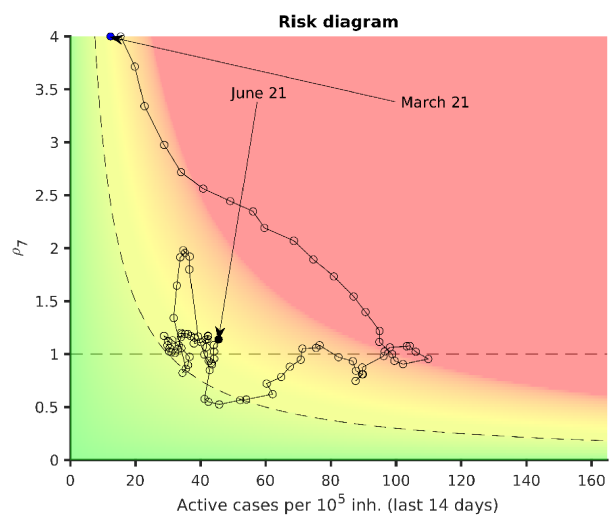
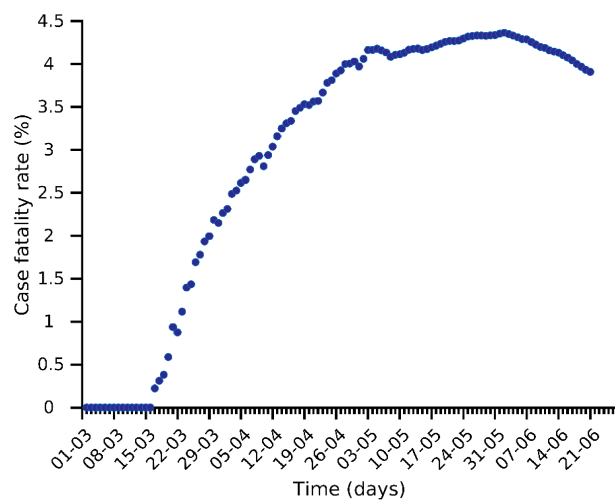
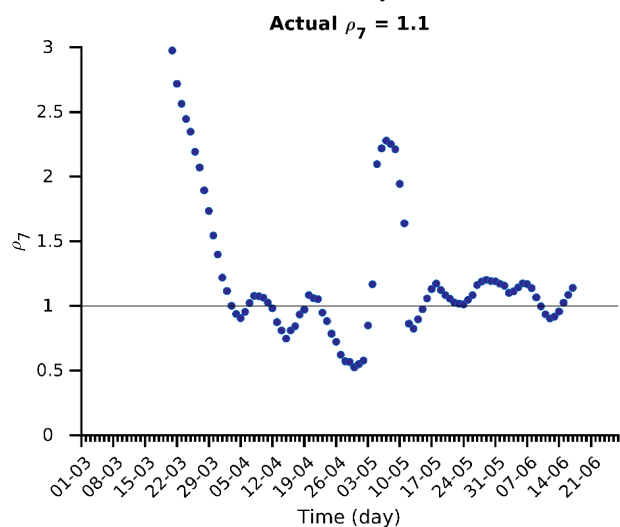
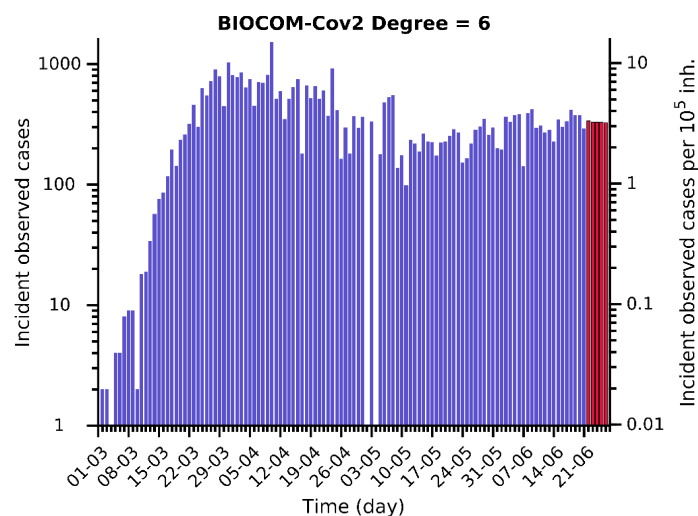
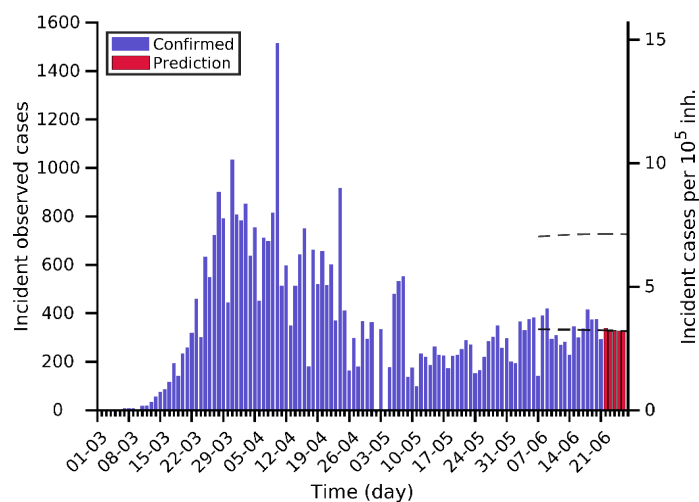
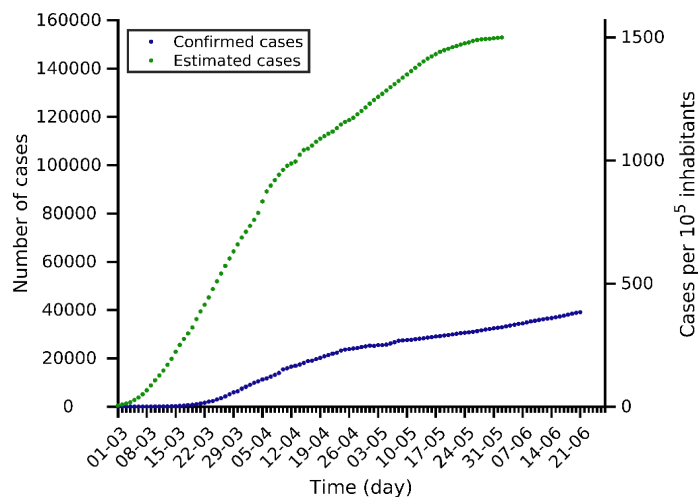
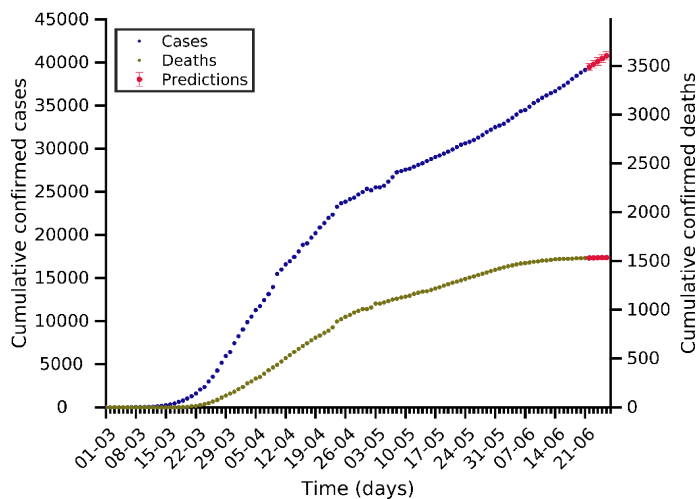


Sweden 21-06-2020. Population: 10.1M. Current cumulative incidence: 555/10⁵

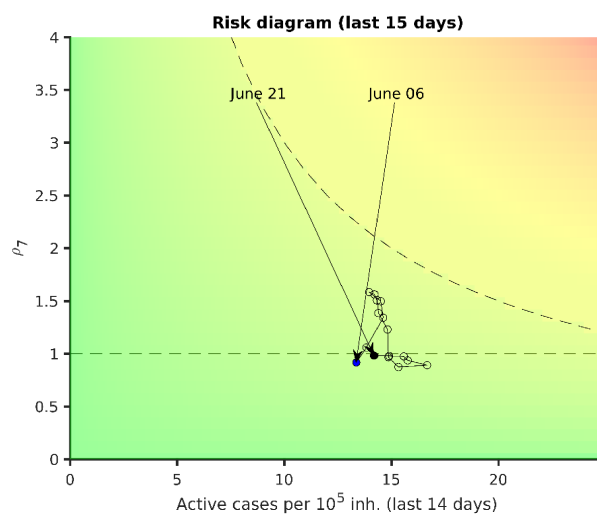
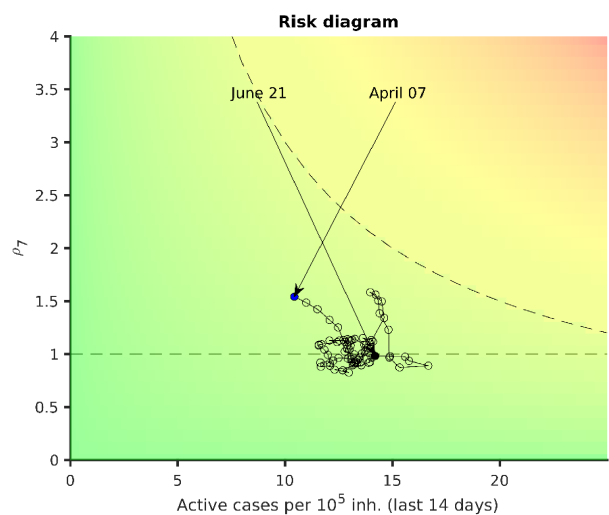
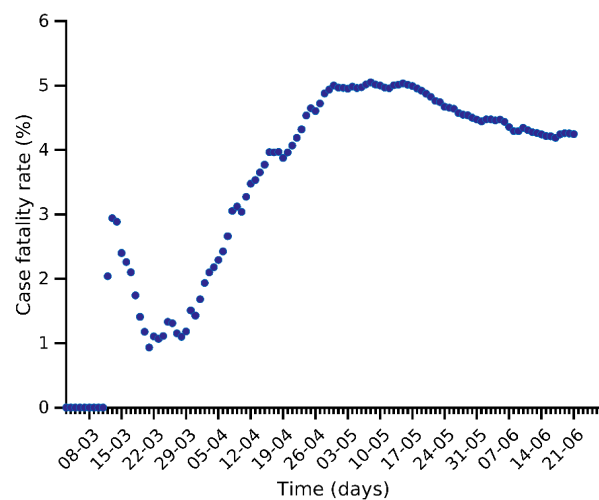
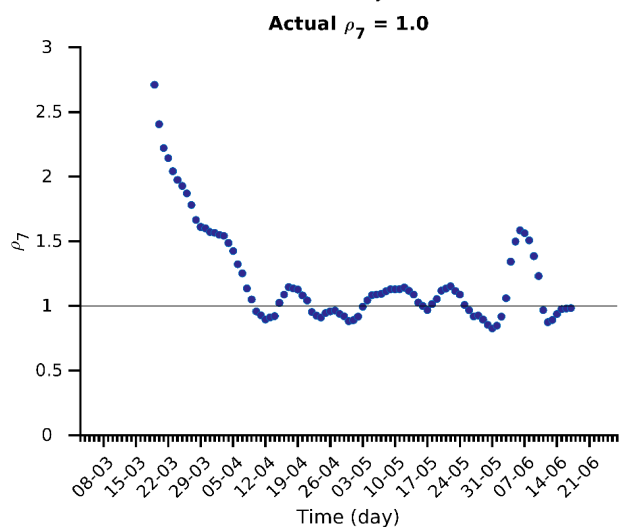
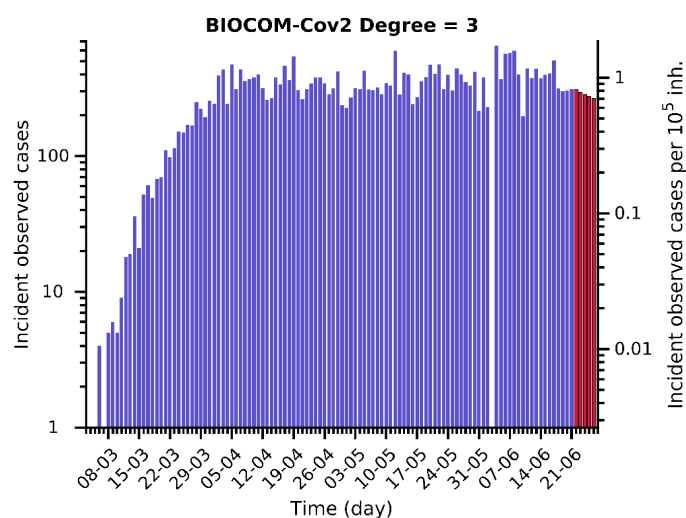
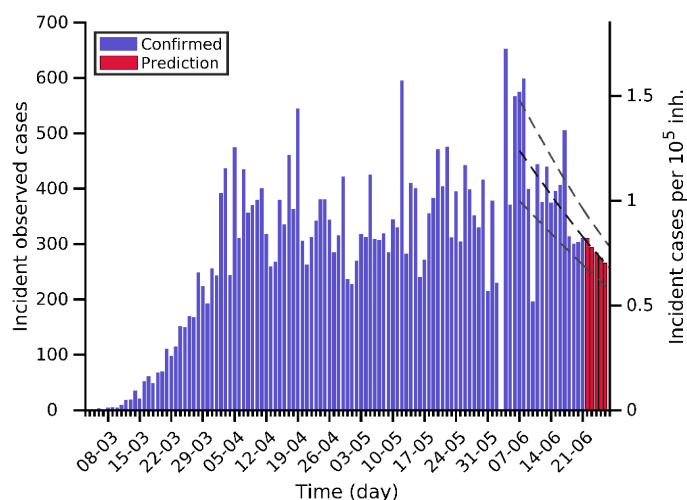
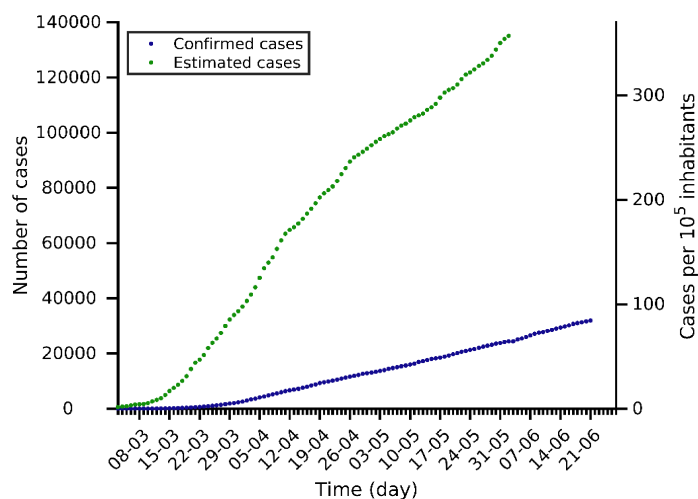
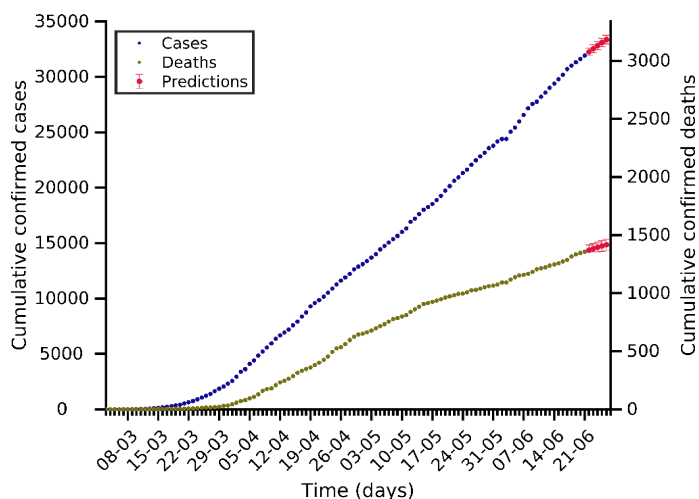




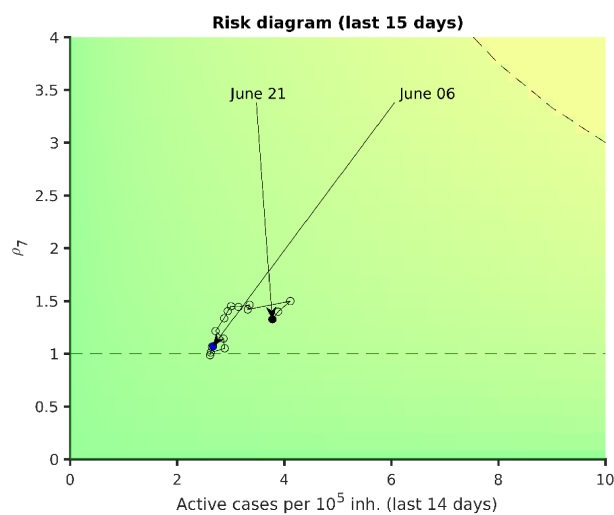
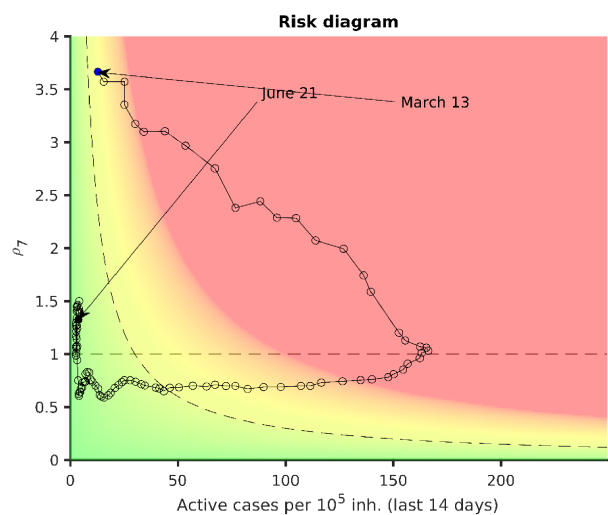
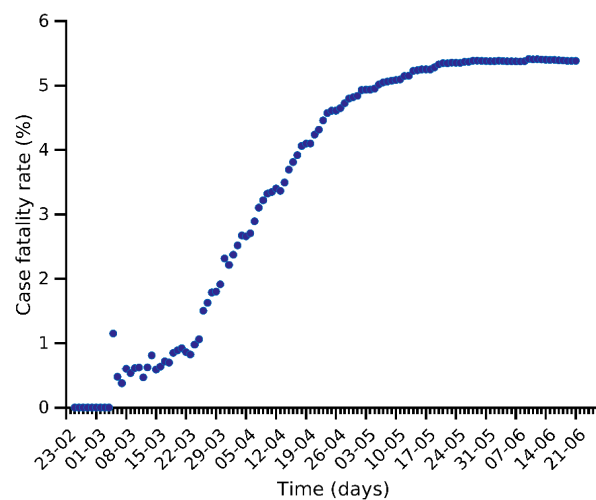
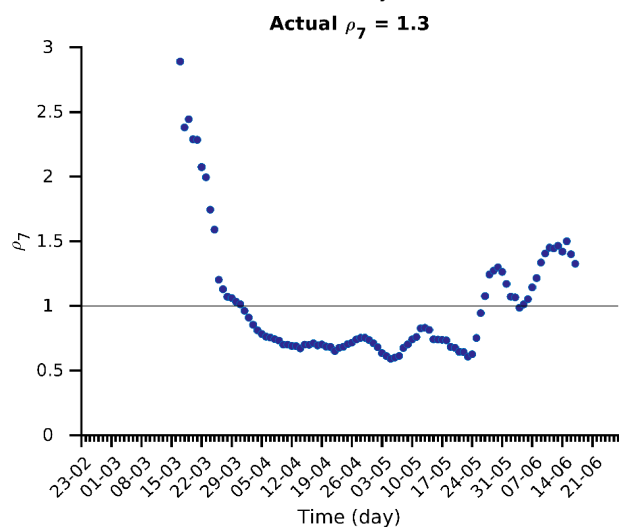
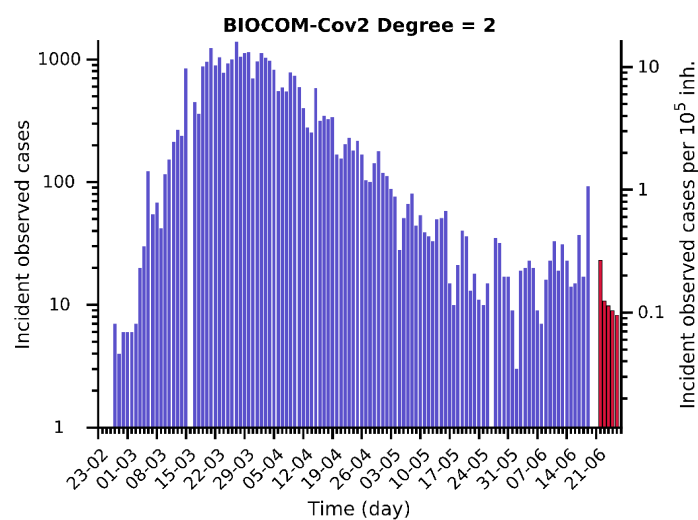
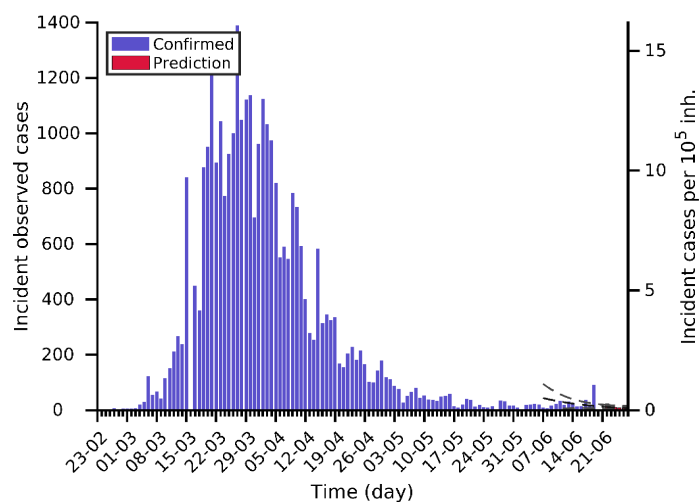
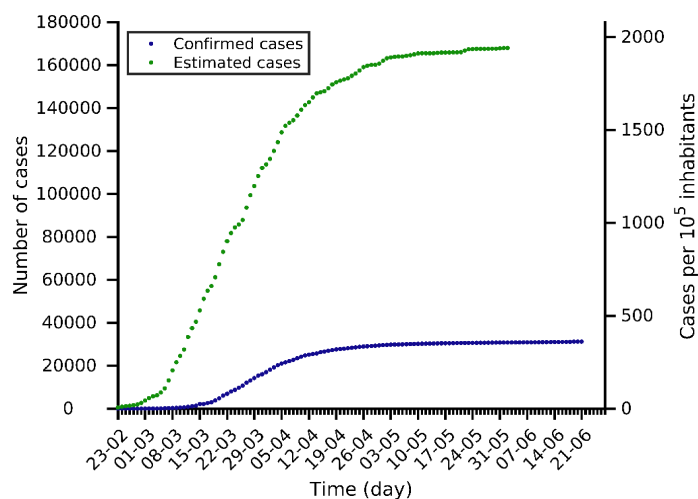
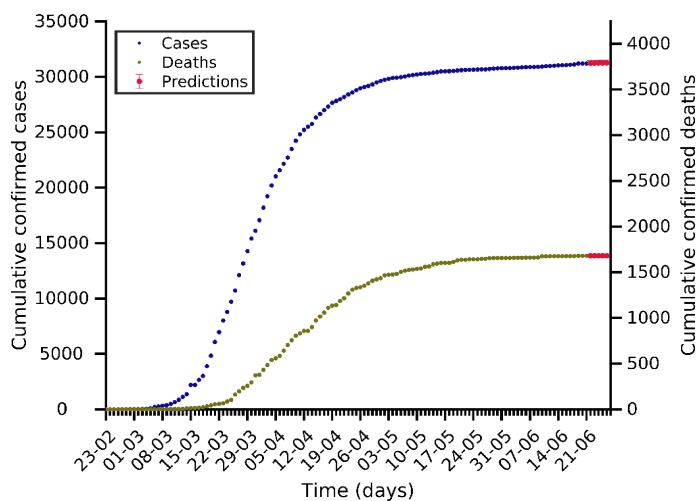
Portugal 21-06-2020. Population: 10.2M. Current cumulative incidence: 384/10⁵



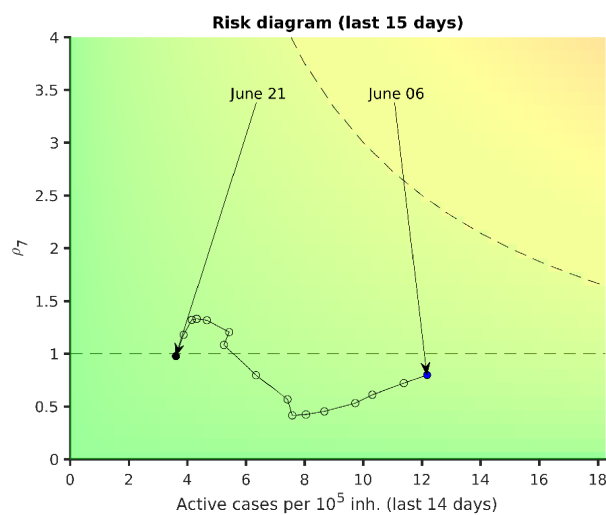
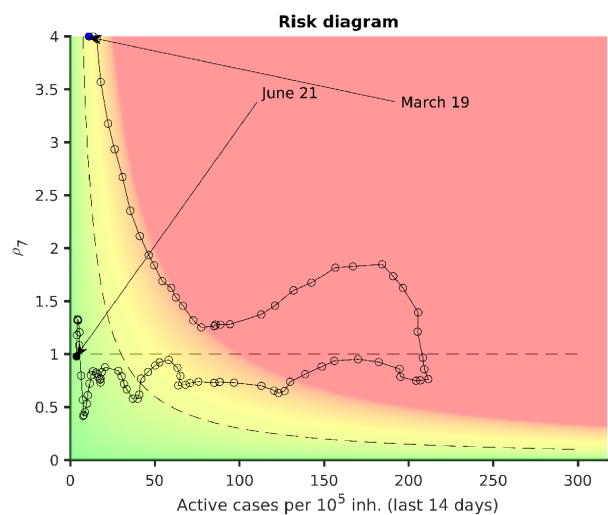
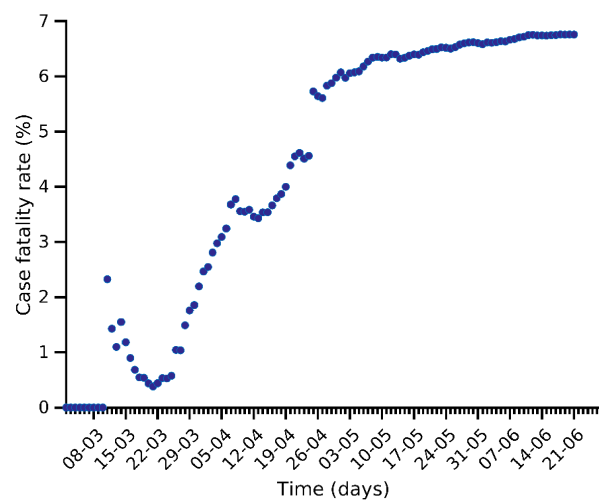
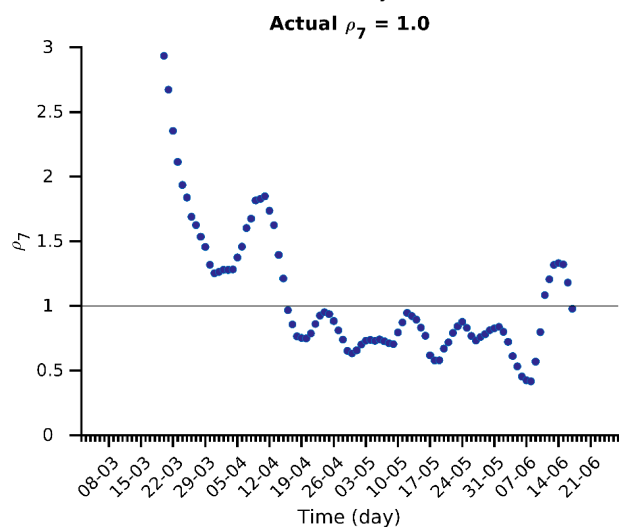
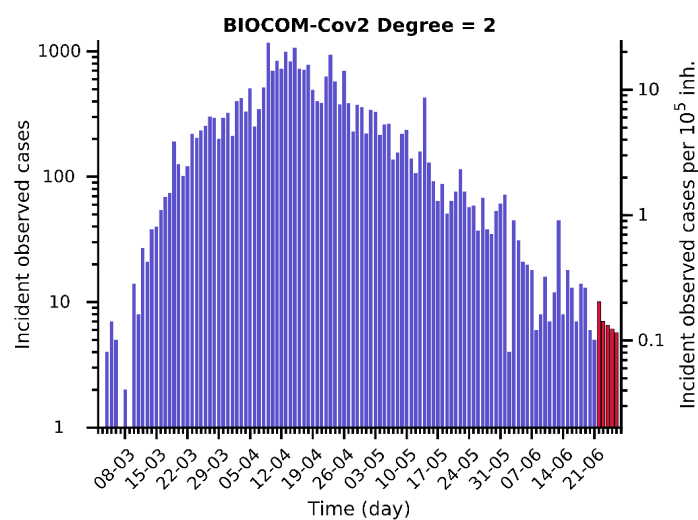
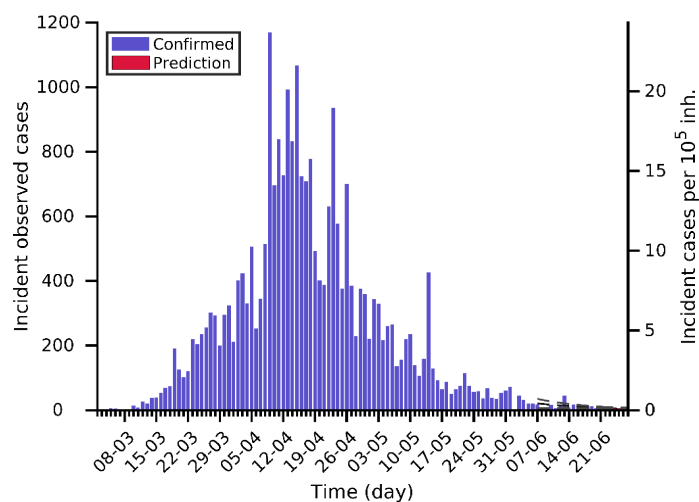
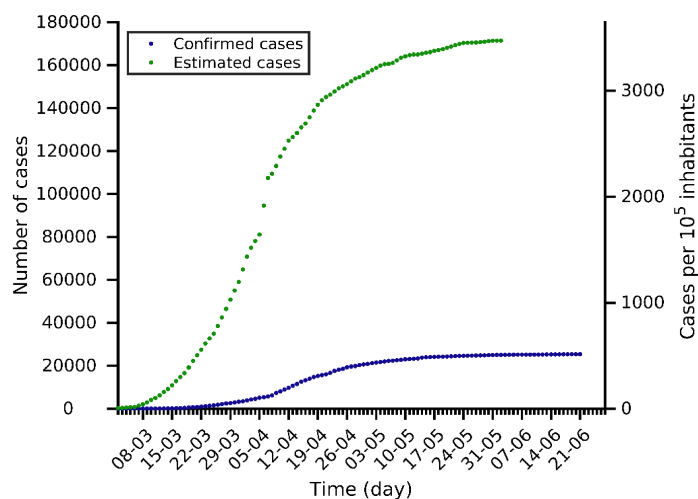
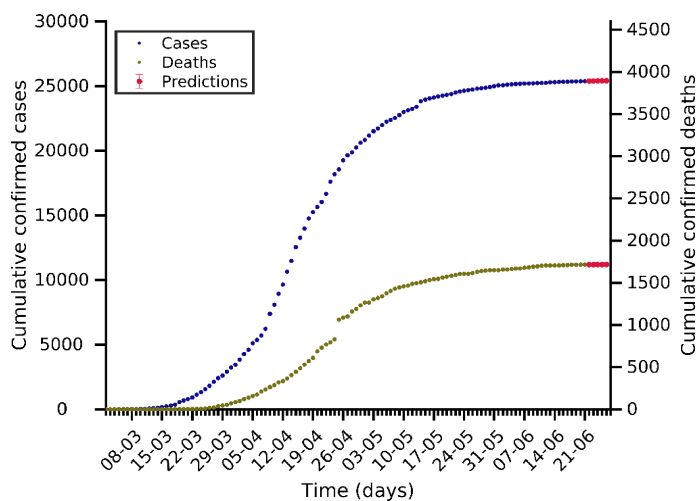
Poland 21-06-2020. Population: 37.8M. Current cumulative incidence: 84/10⁵



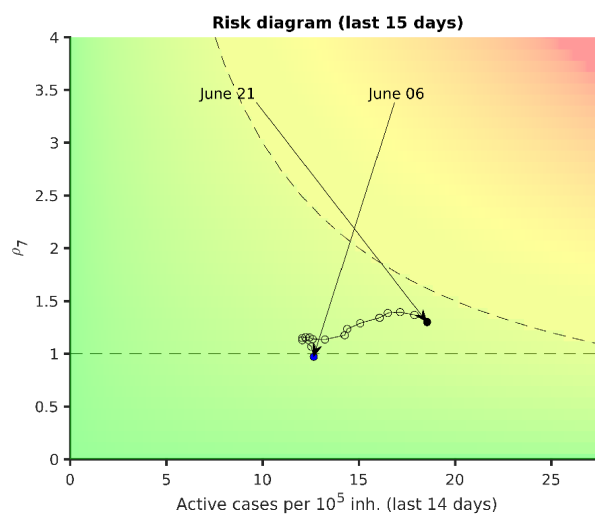
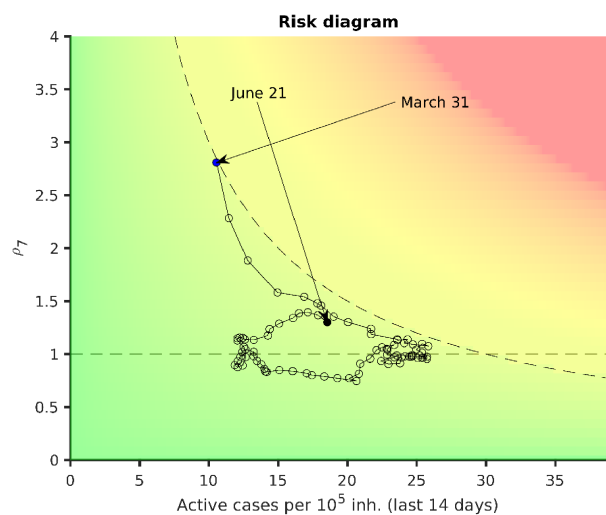
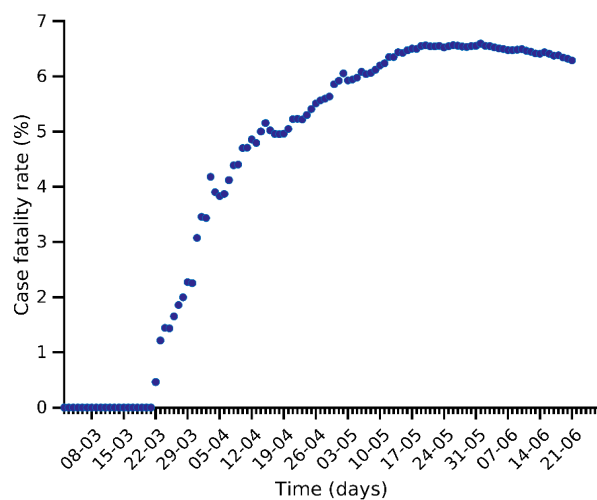
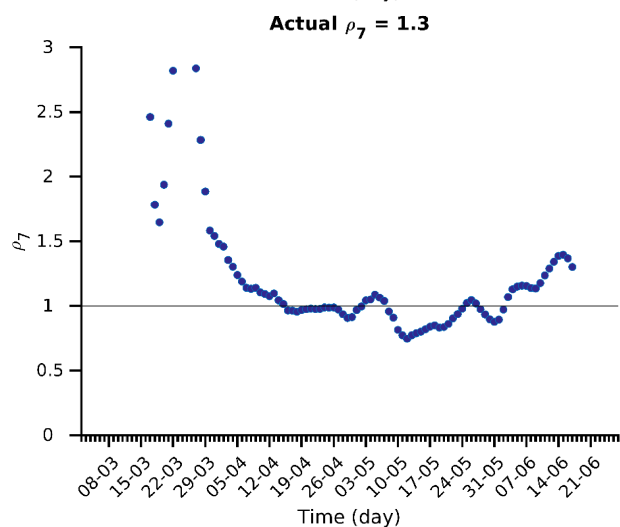
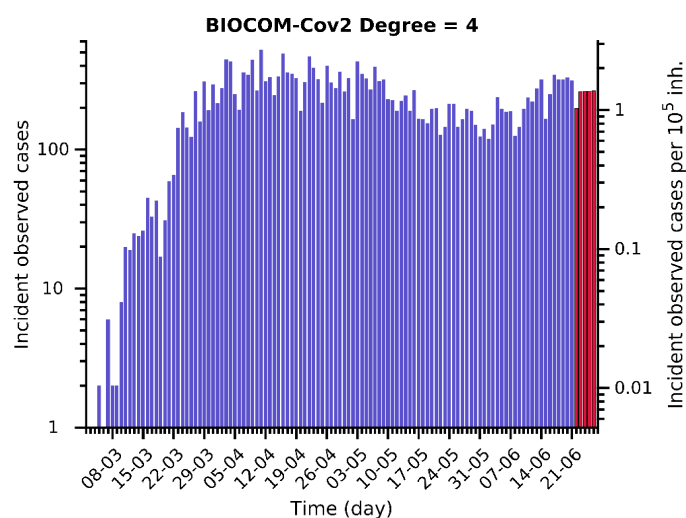
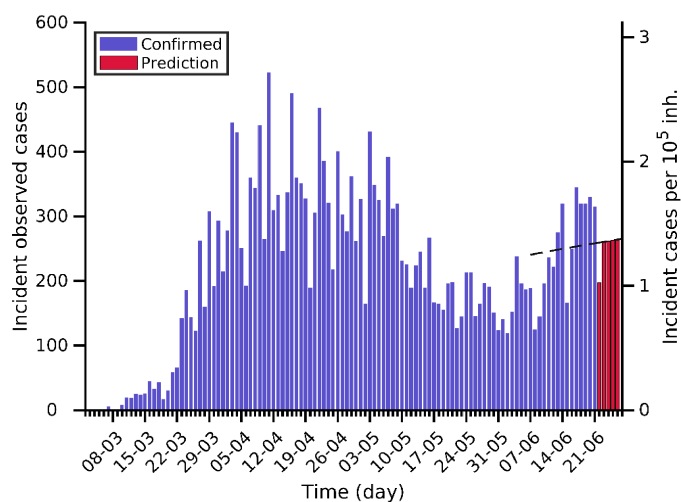
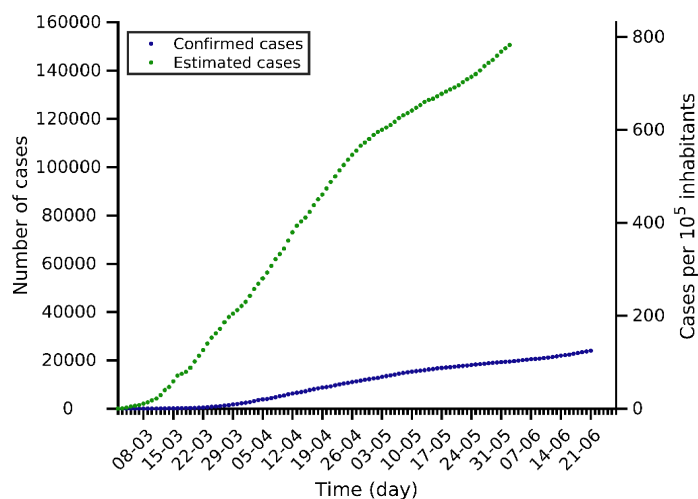
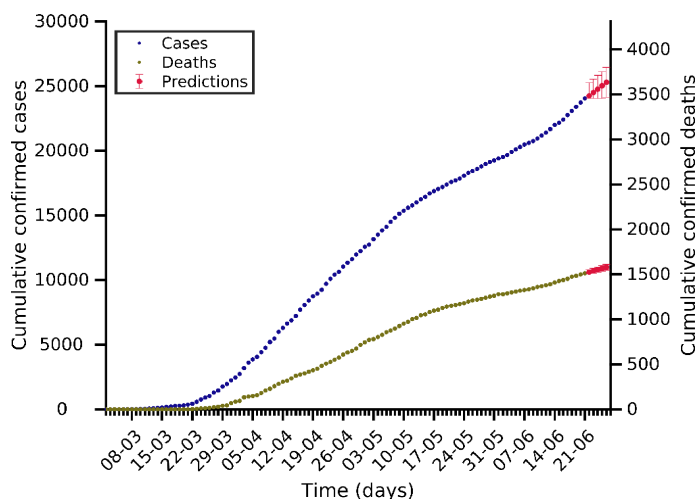
Switzerland 21-06-2020. Population: 8.7M. Current cumulative incidence: 361/10⁵



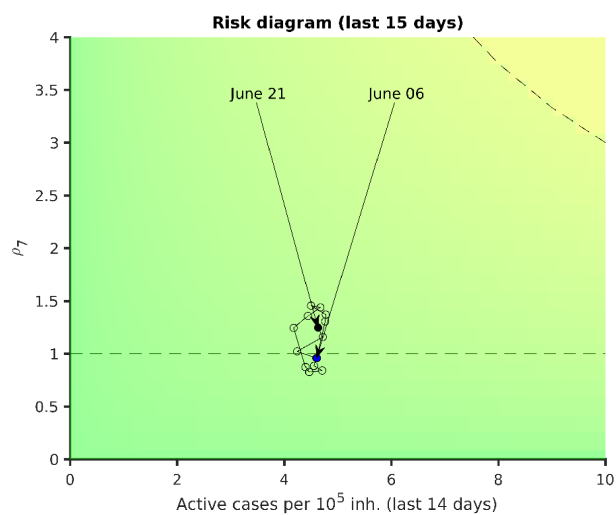
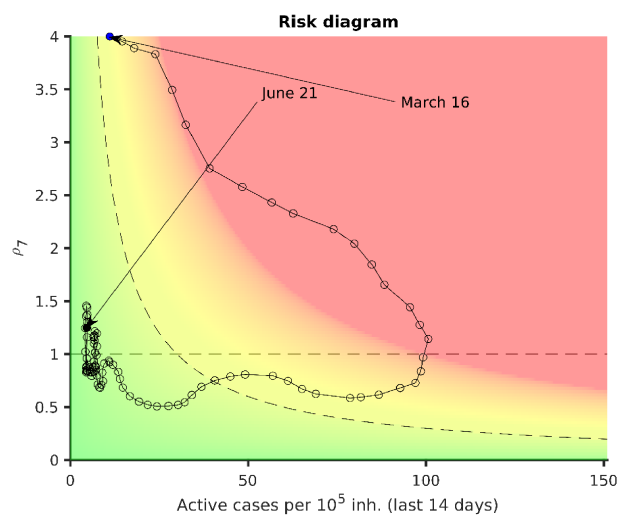
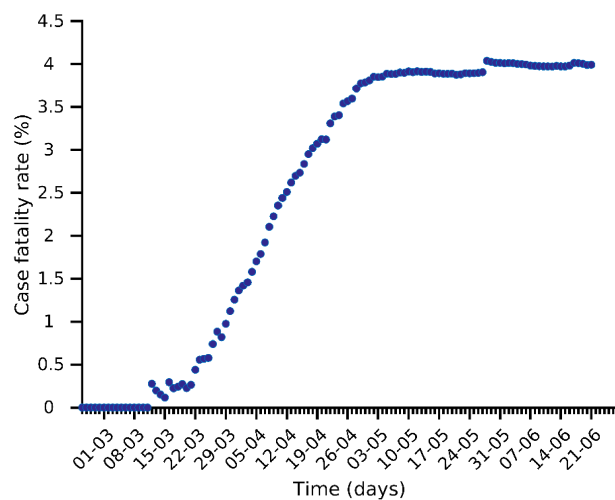
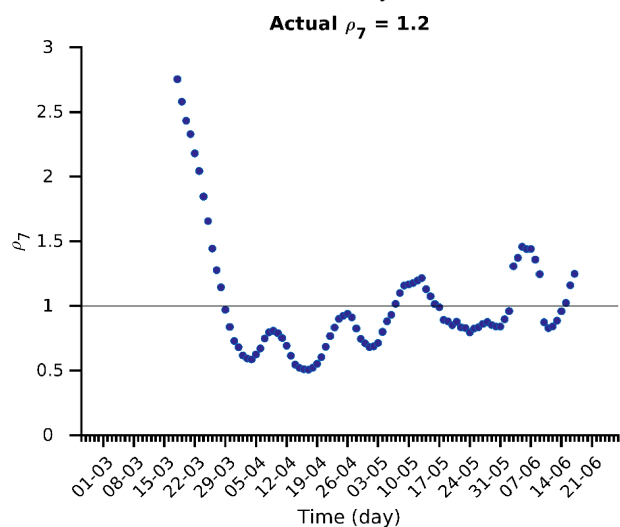
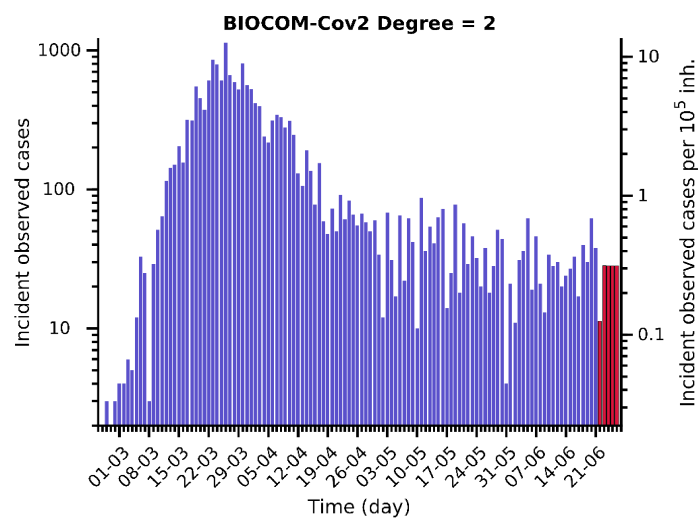
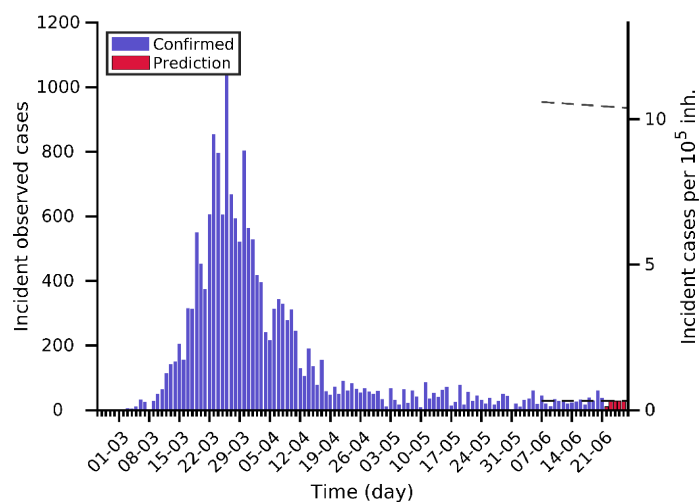
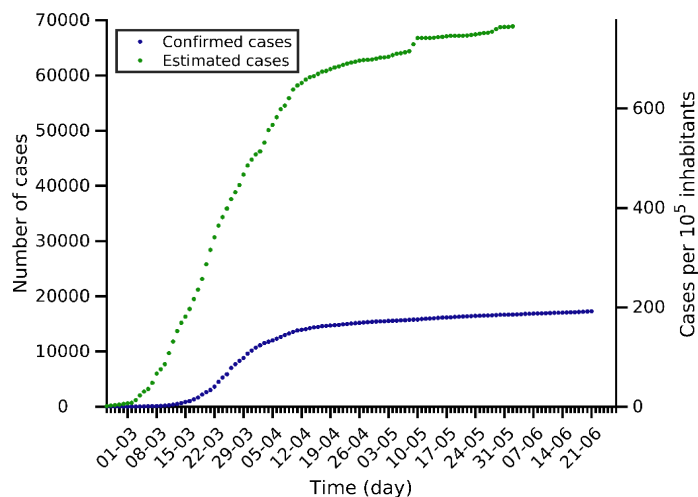
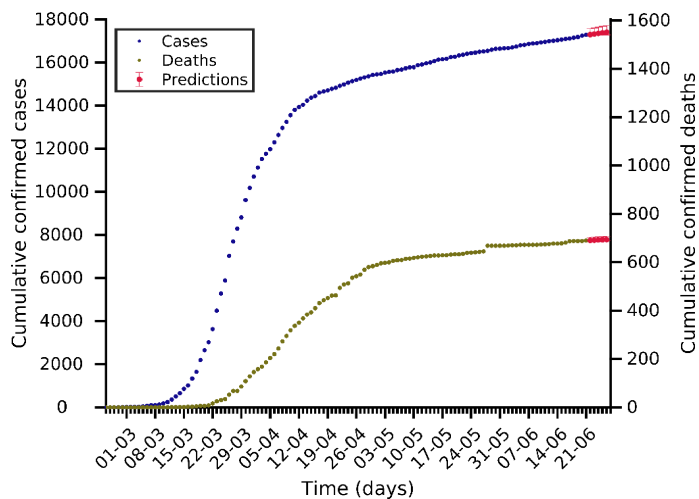
Ireland 21-06-2020. Population: 4.9M. Current cumulative incidence: 514/10⁵



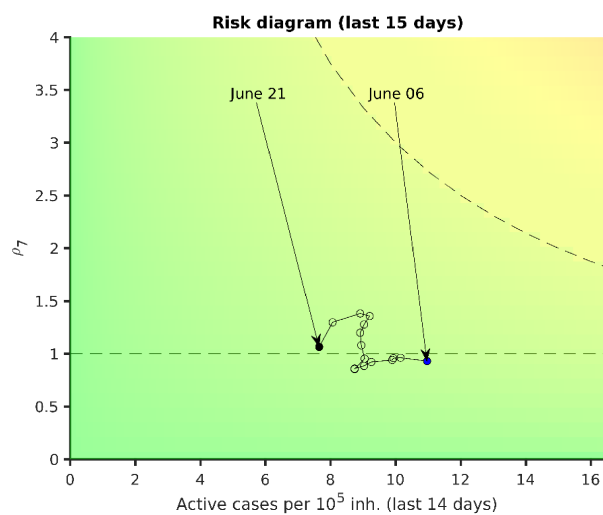
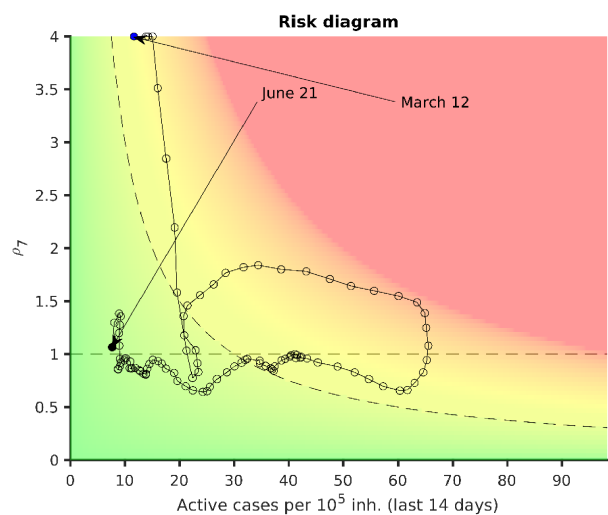
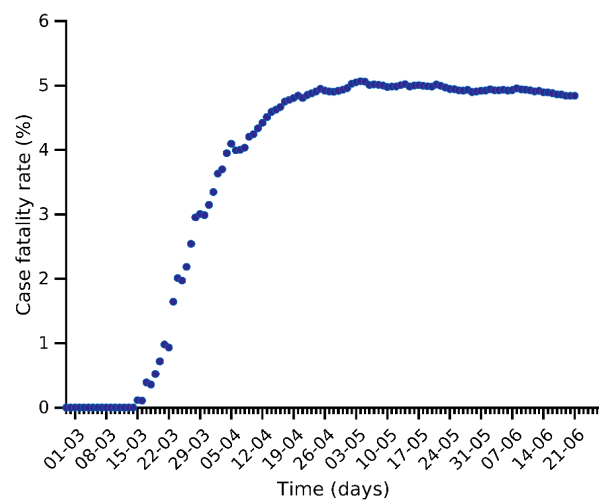
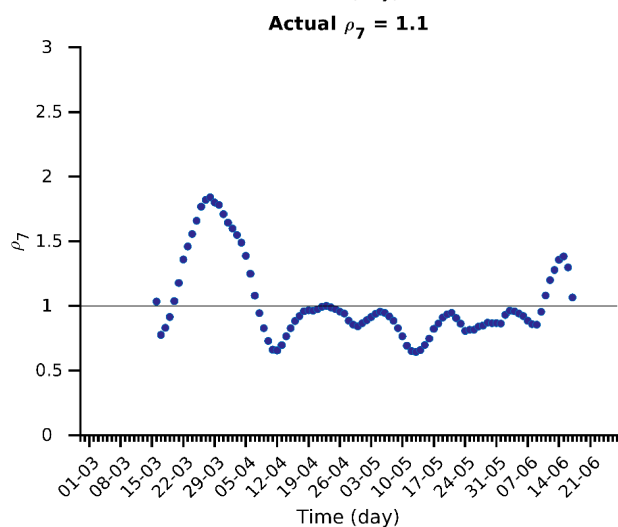
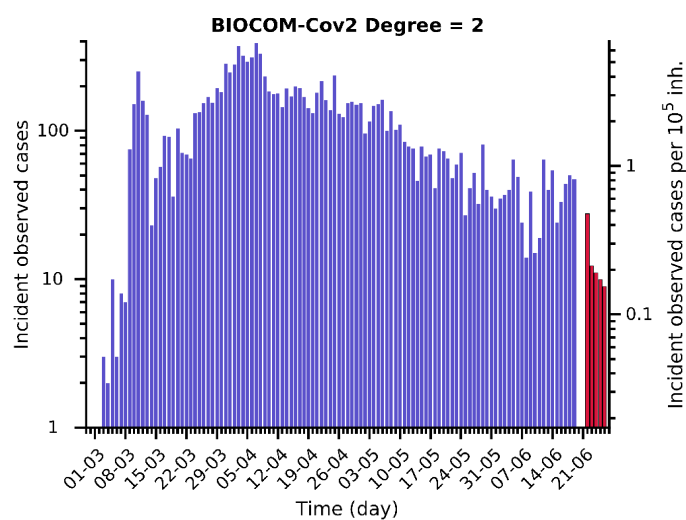
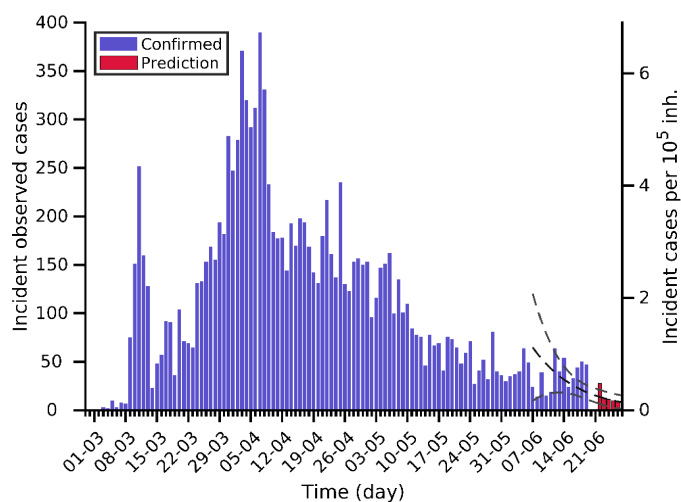
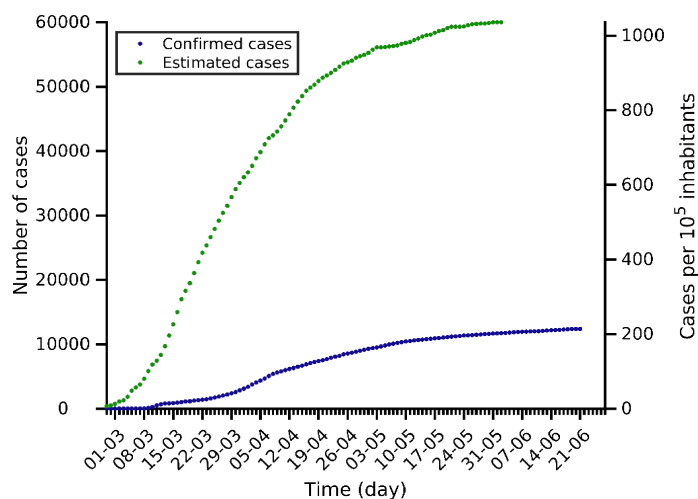
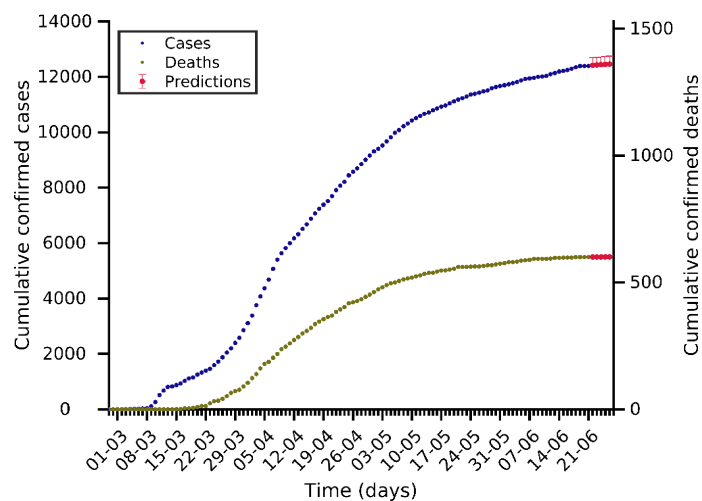
Romania 21-06-2020. Population: 19.2M. Current cumulative incidence: 125/10⁵



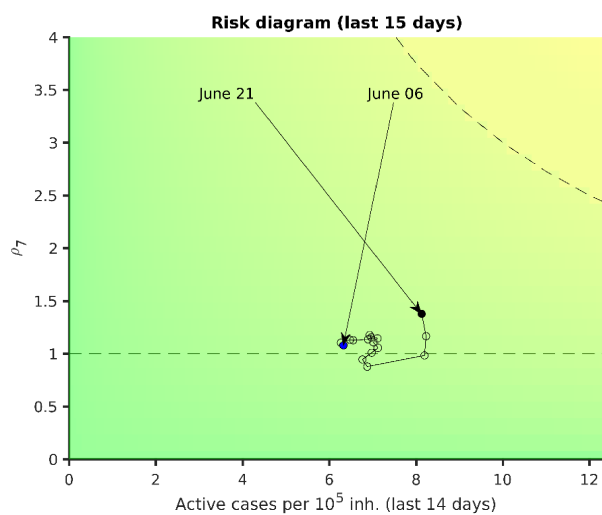
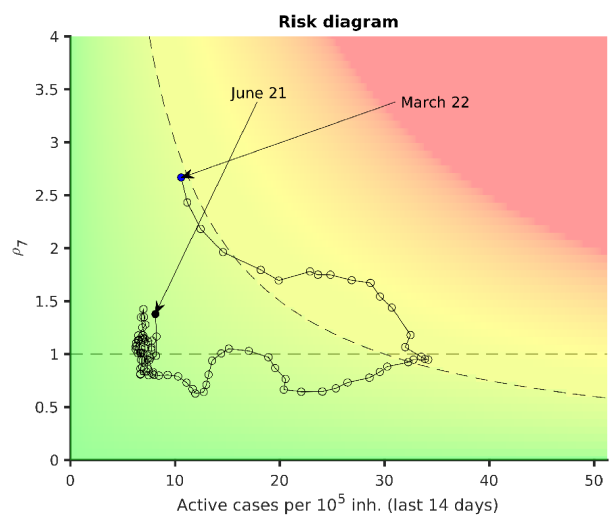
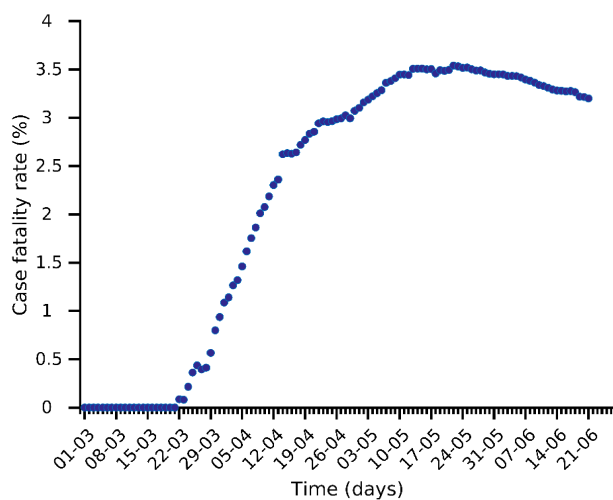
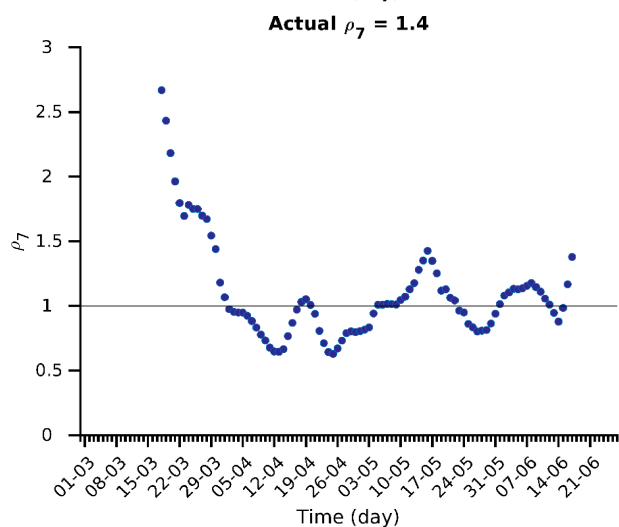
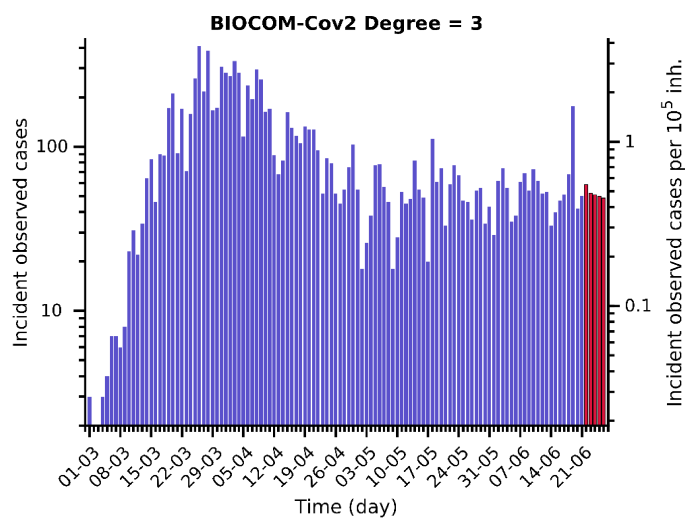
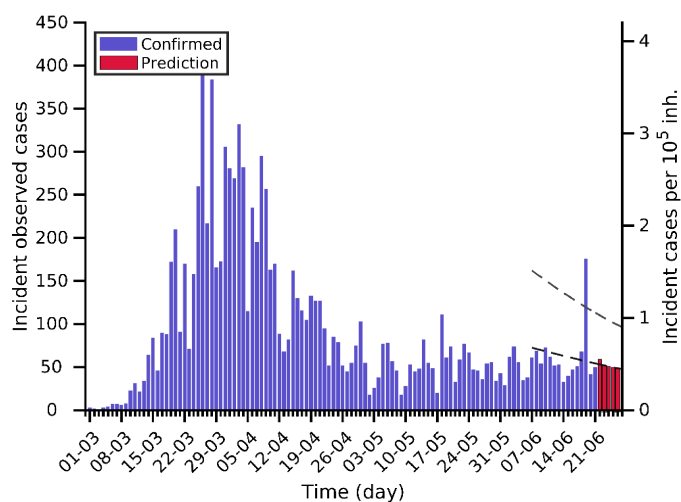
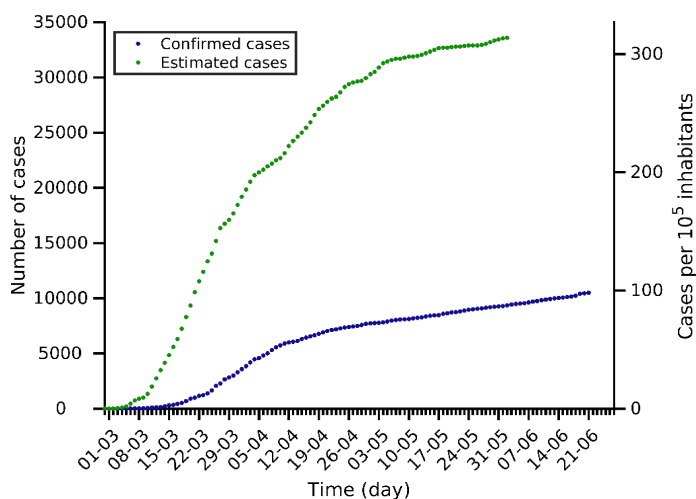
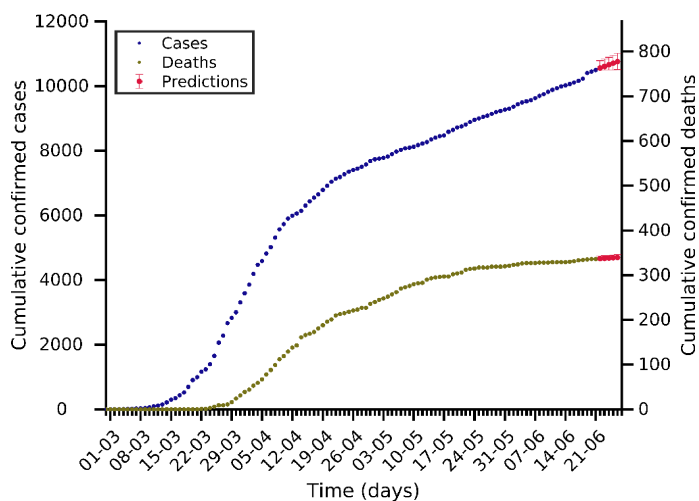
Austria 21-06-2020. Population: 9.0M. Current cumulative incidence: 192/10⁵



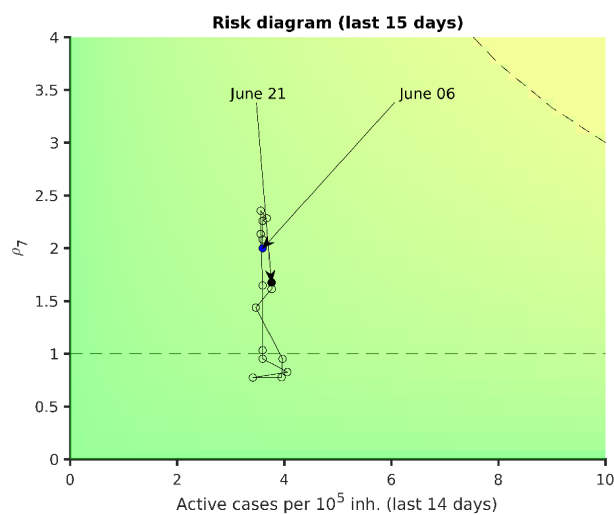
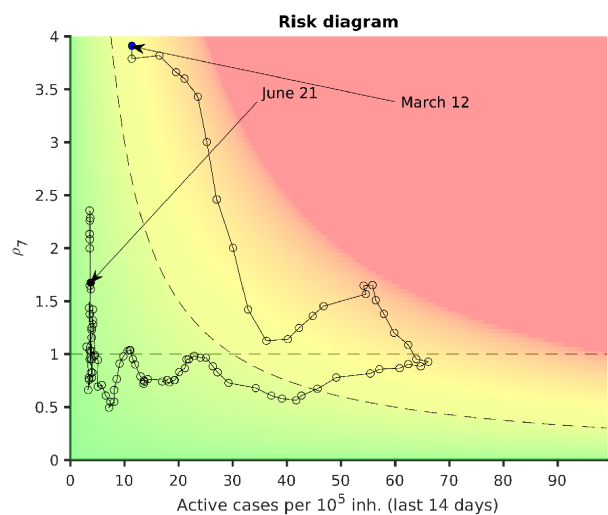
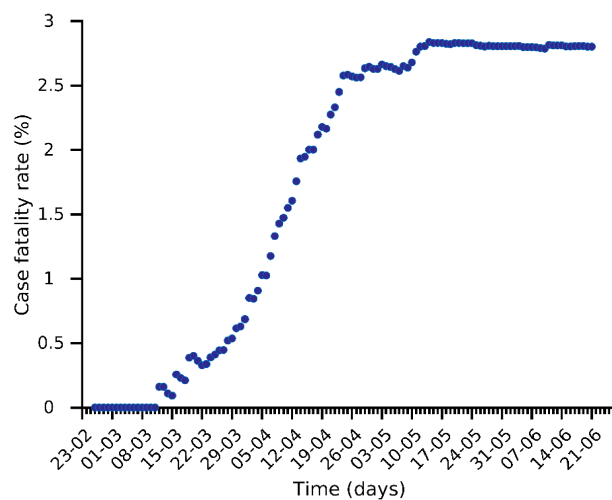
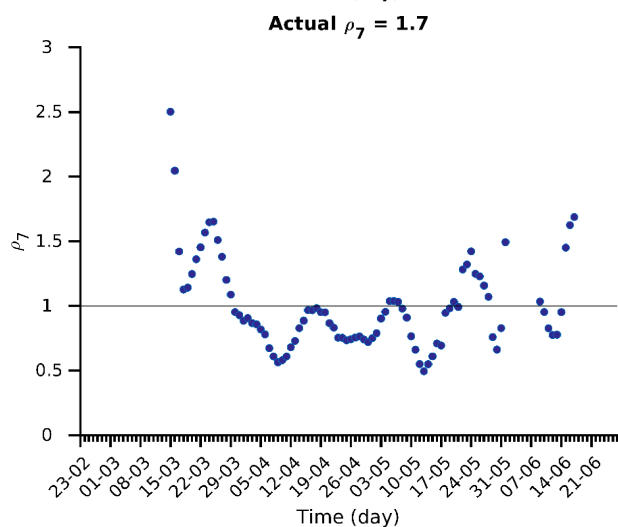
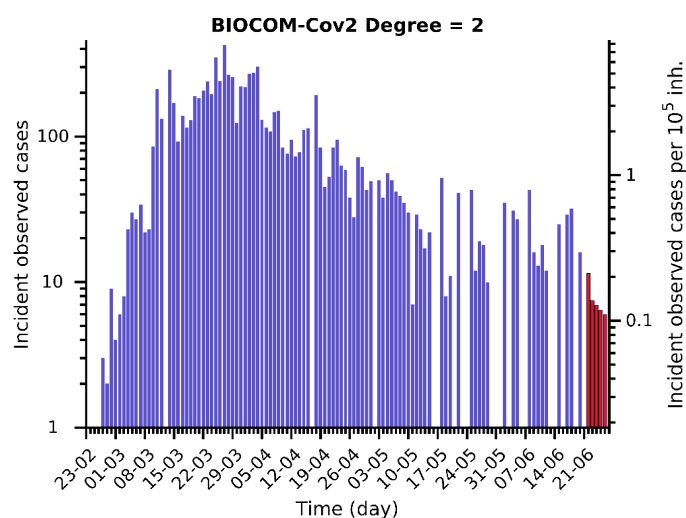
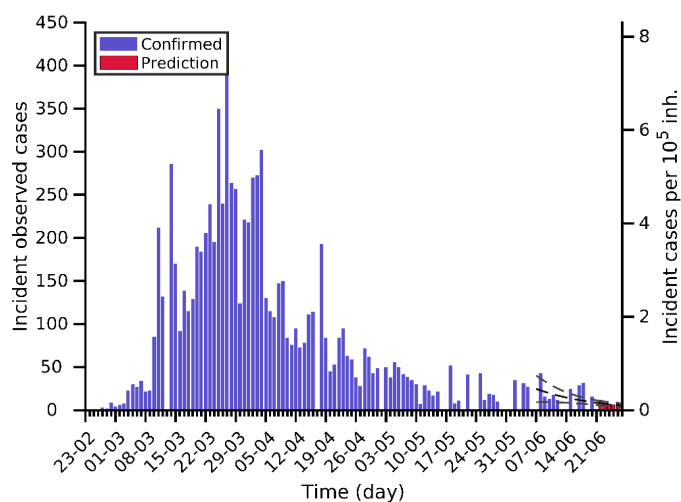
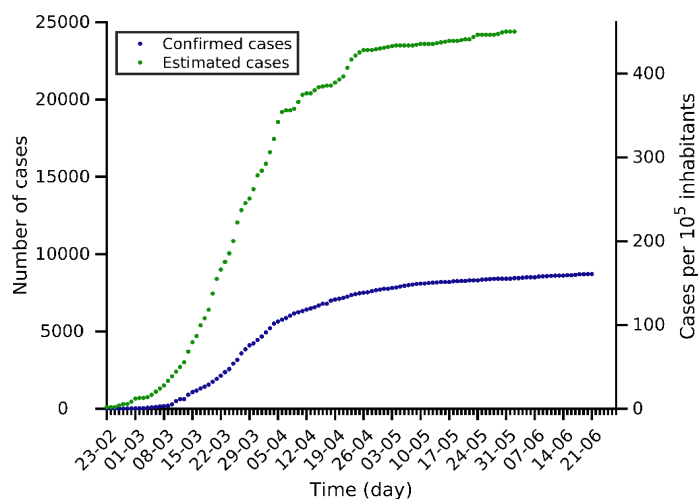
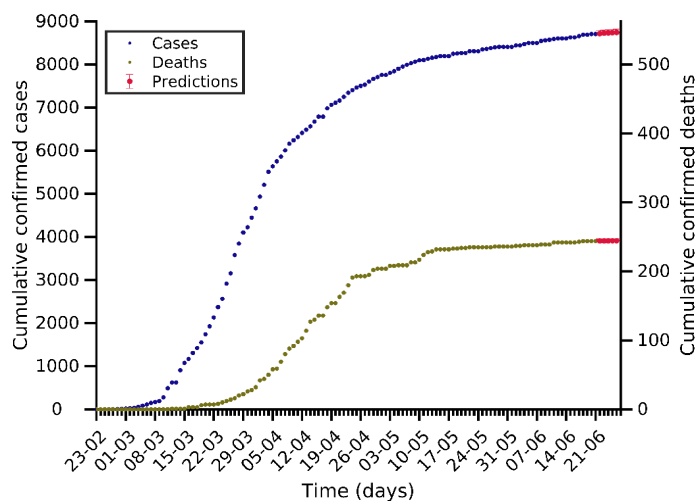
Denmark 21-06-2020. Population: 5.8M. Current cumulative incidence: 214/10⁵



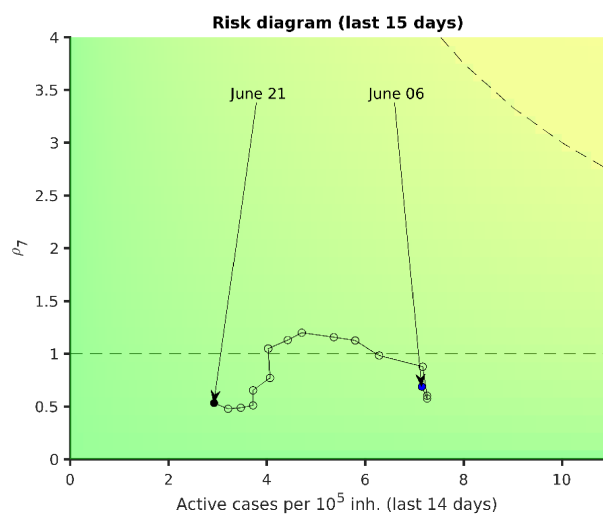
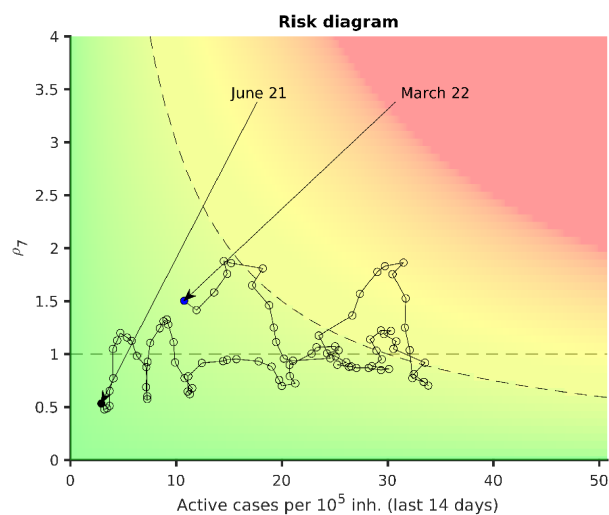
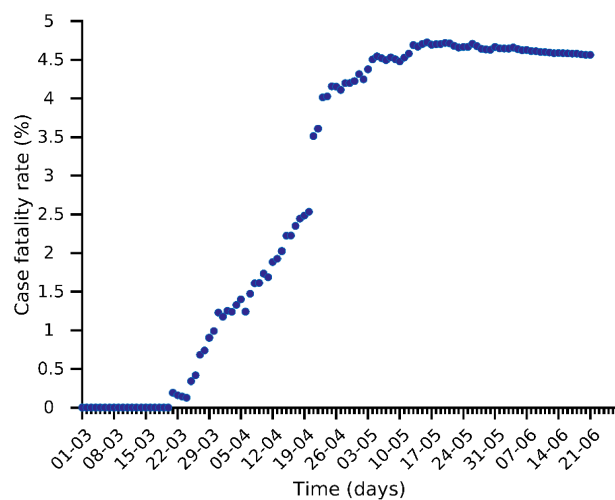
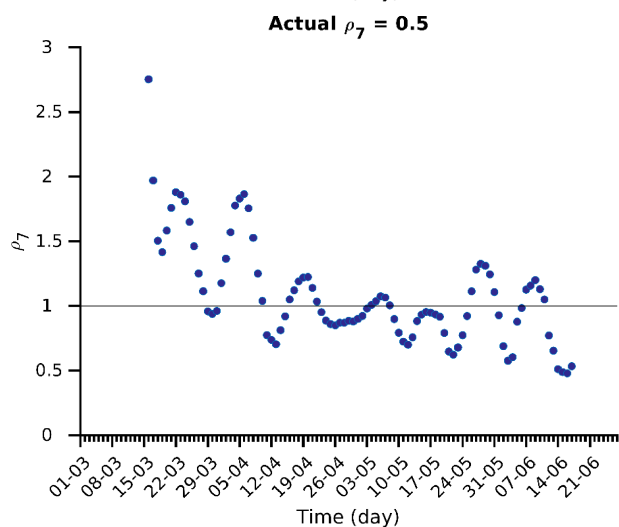
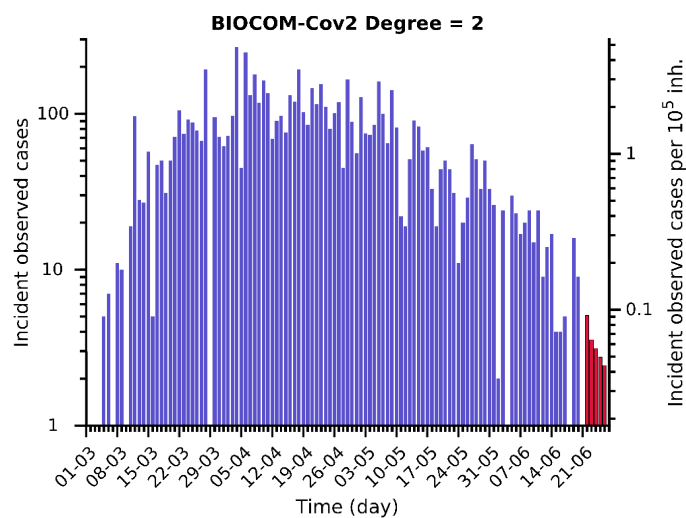
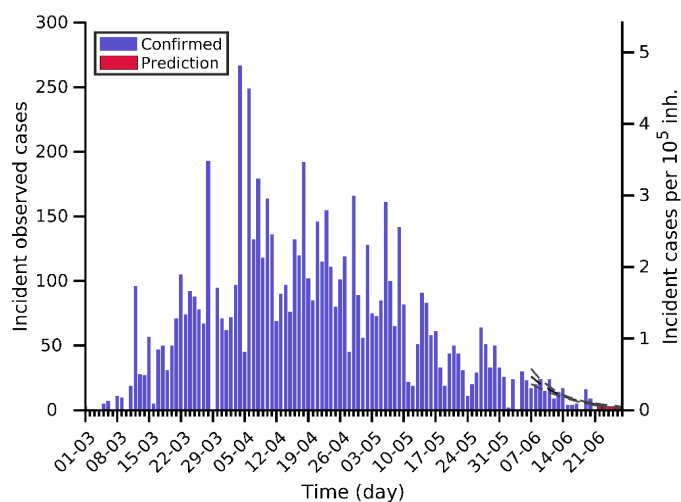
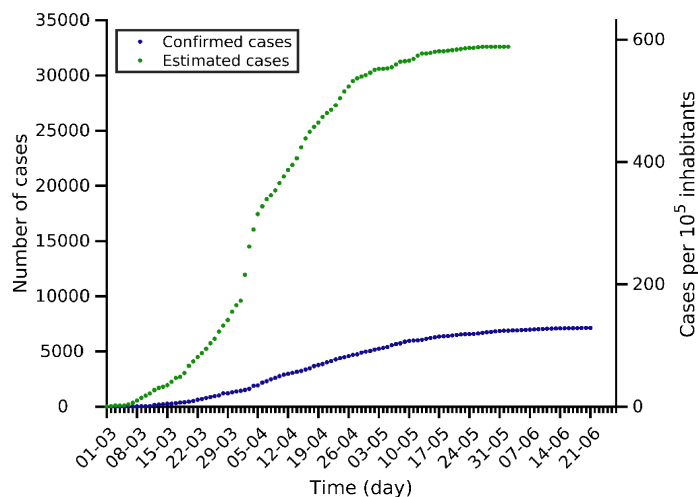
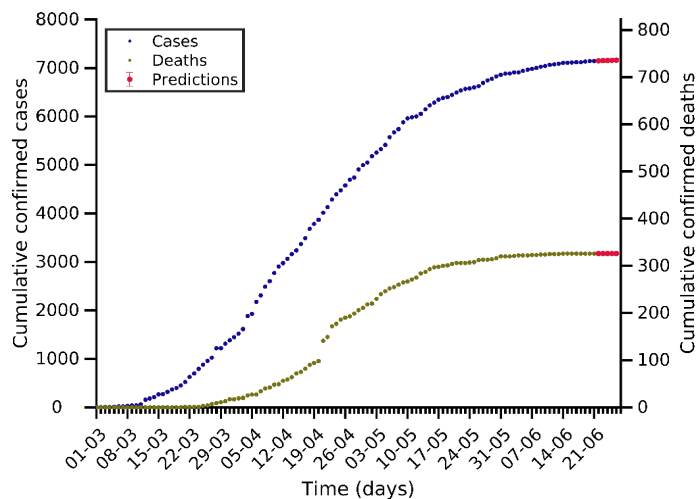
Czech Rep 21-06-2020. Population: 10.7M. Current cumulative incidence: 98/10⁵



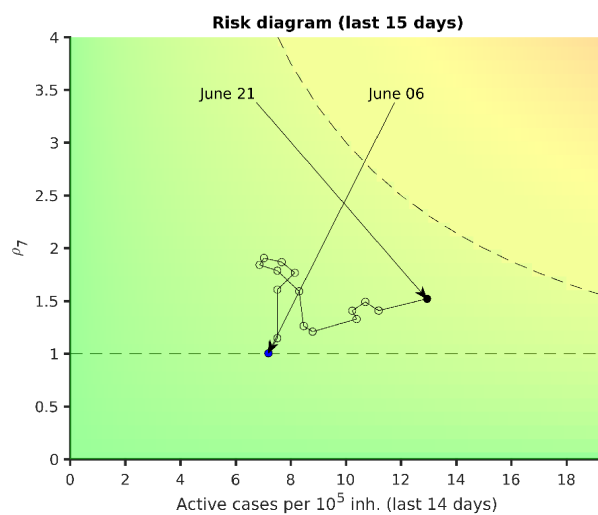
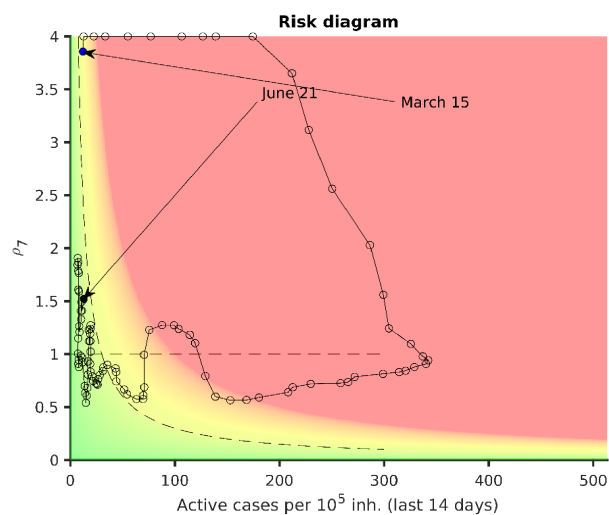
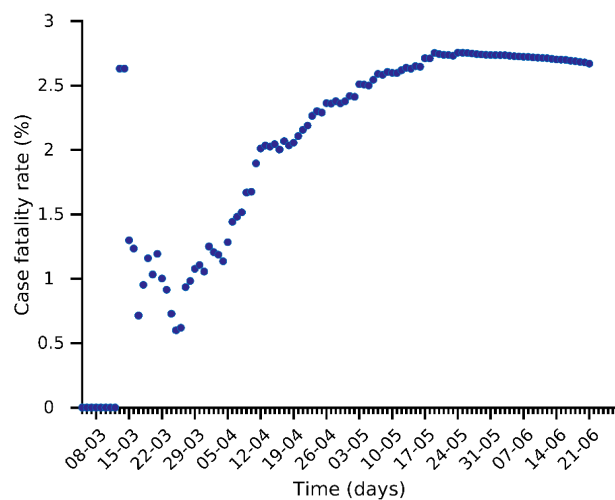
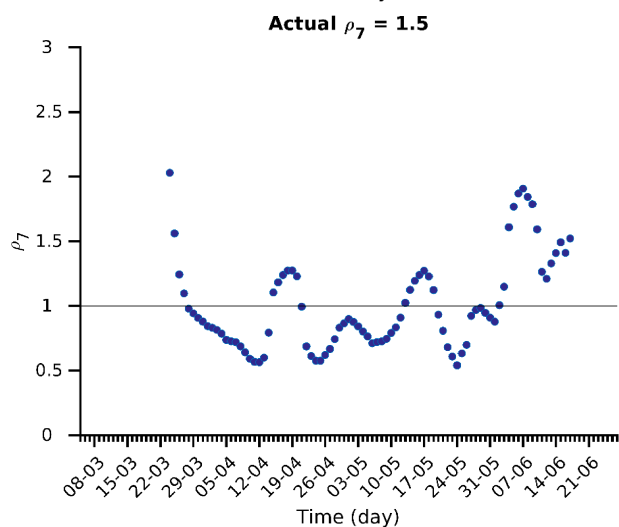
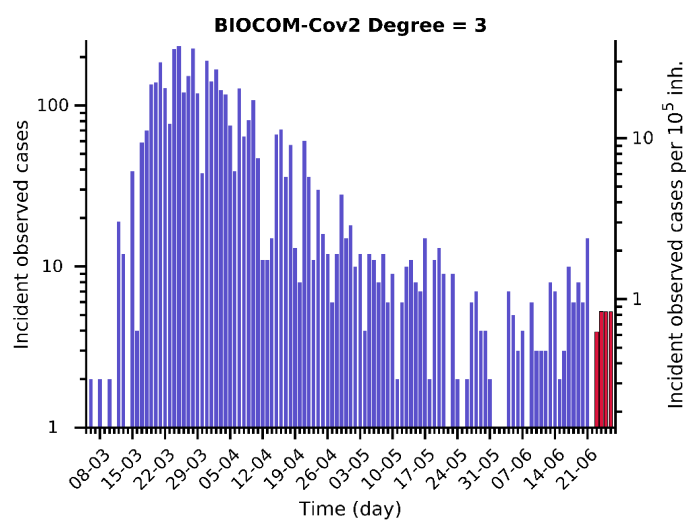
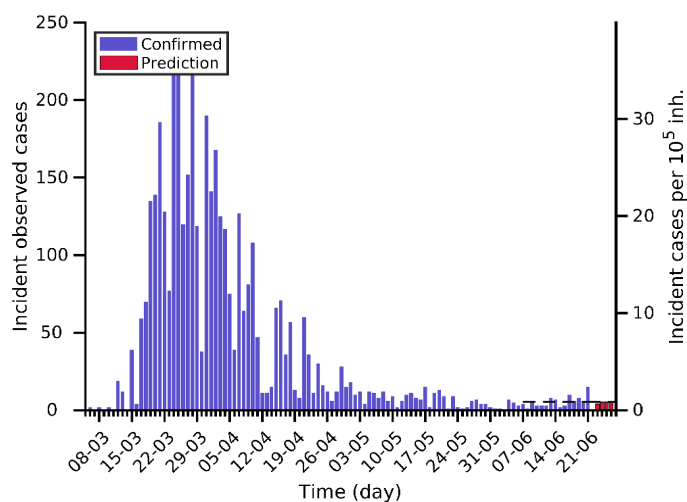
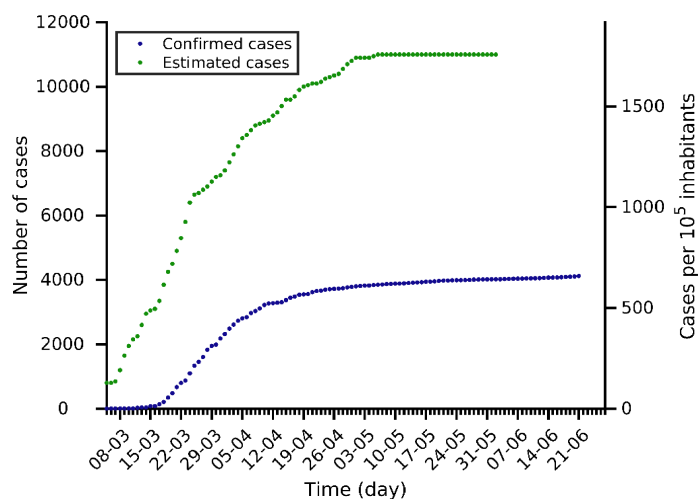
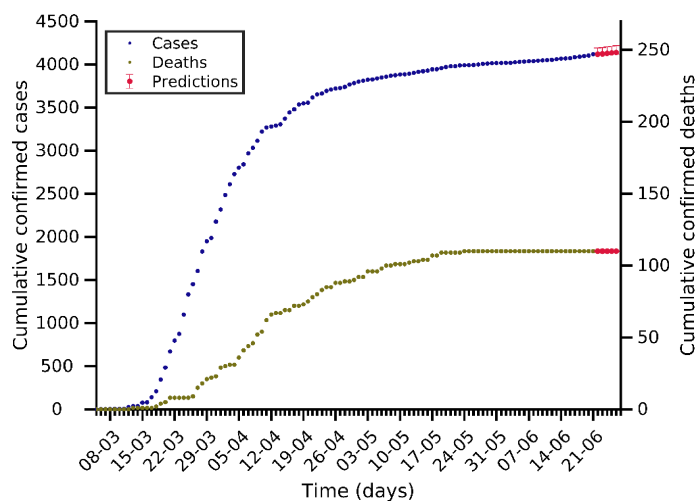
Norway 21-06-2020. Population: 5.4M. Current cumulative incidence: 161/10⁵



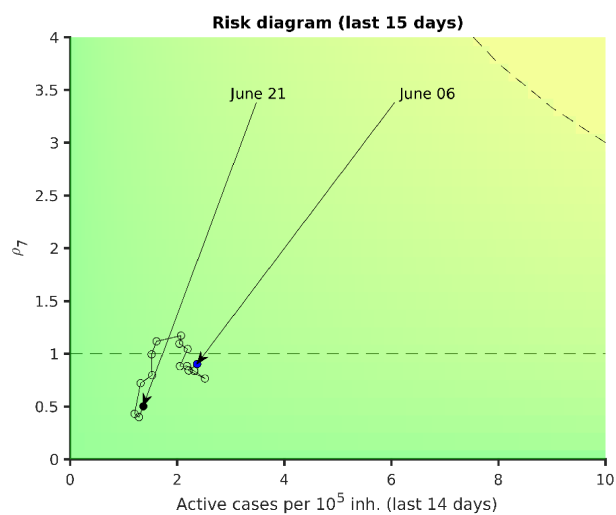
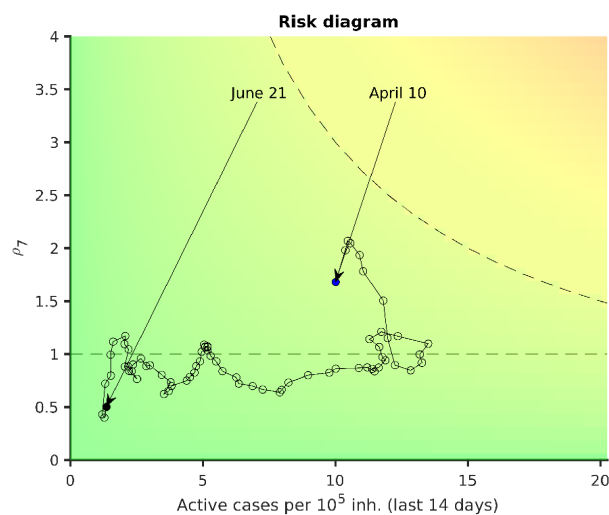
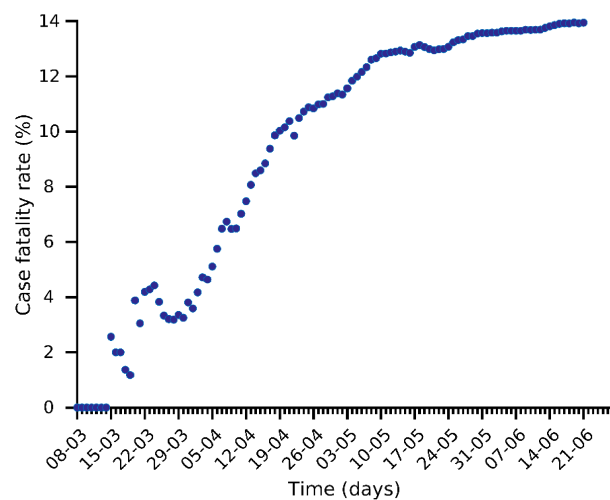
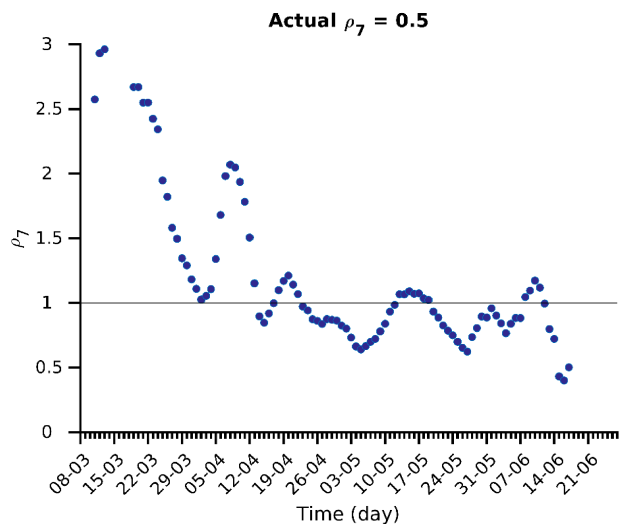
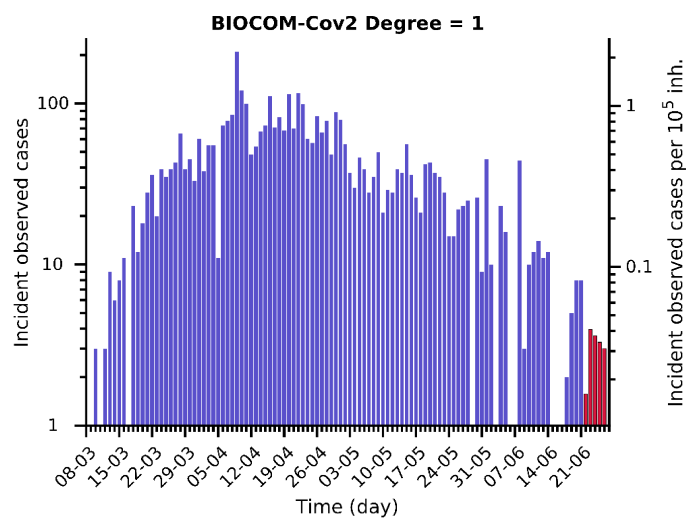
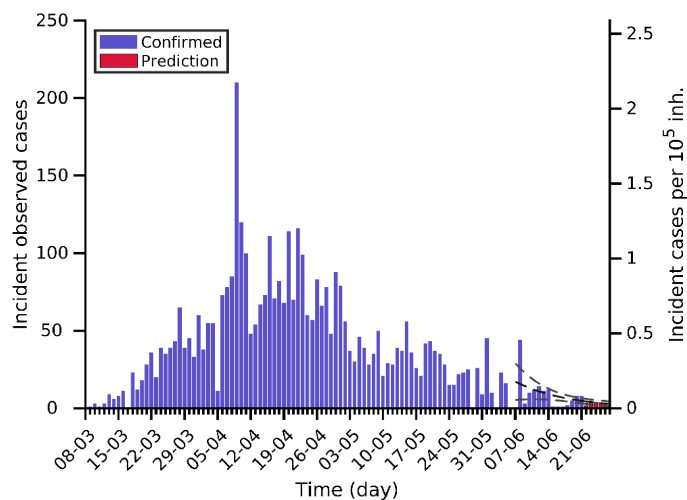
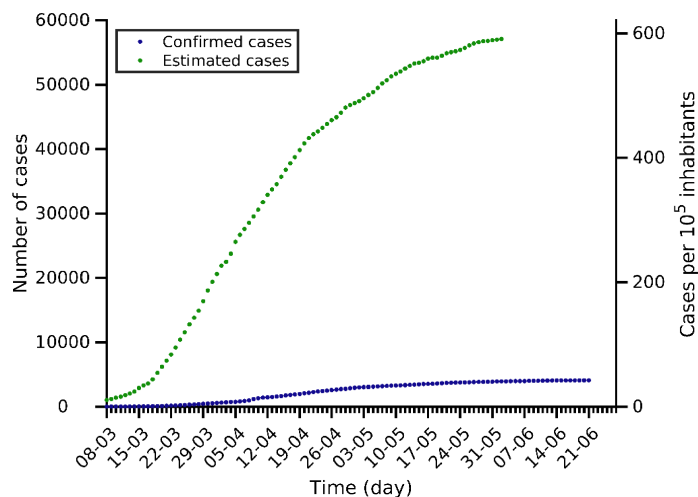
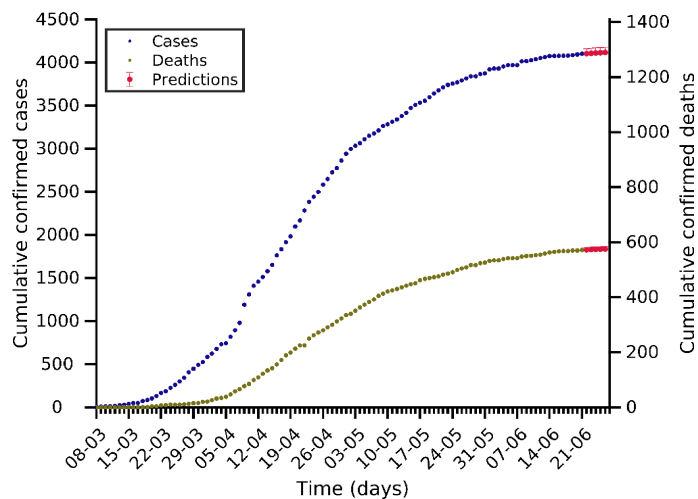
Finland 21-06-2020. Population: 5.5M. Current cumulative incidence: 129/10⁵



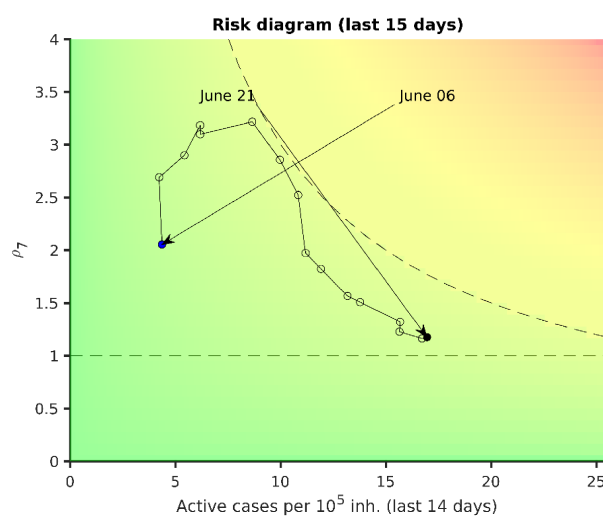
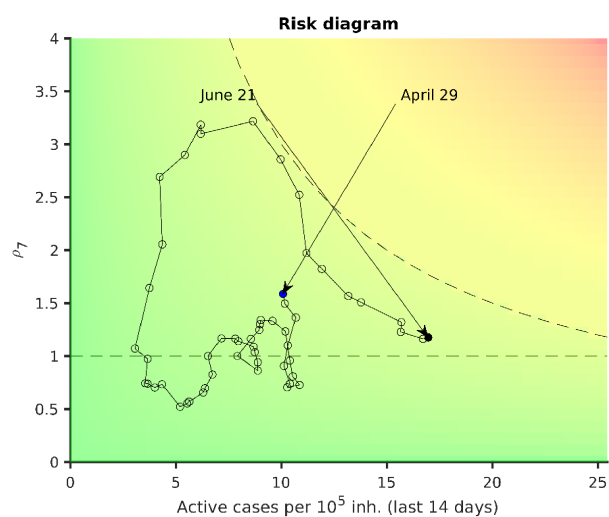
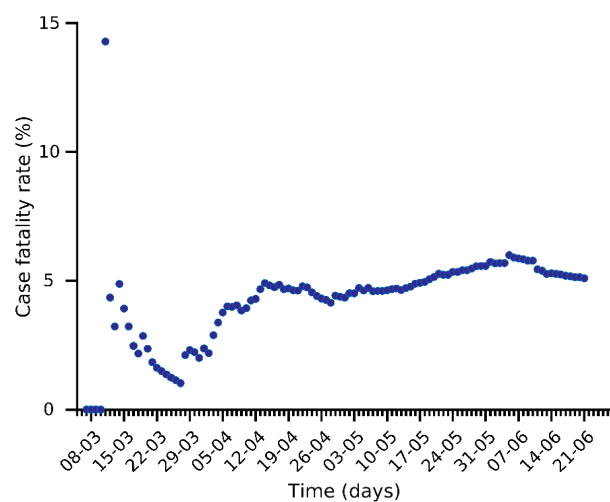
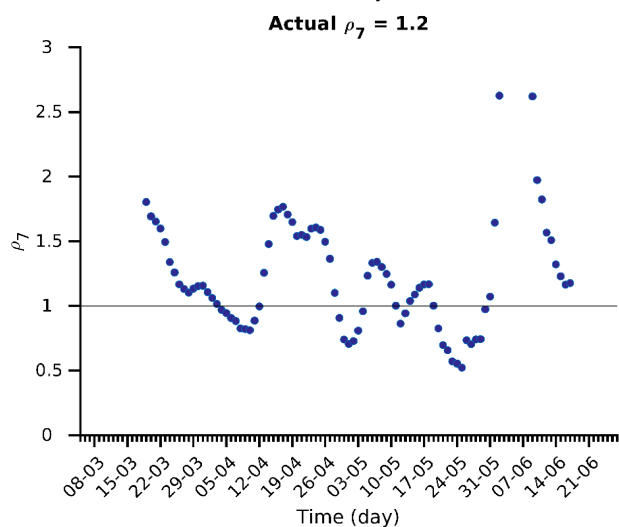
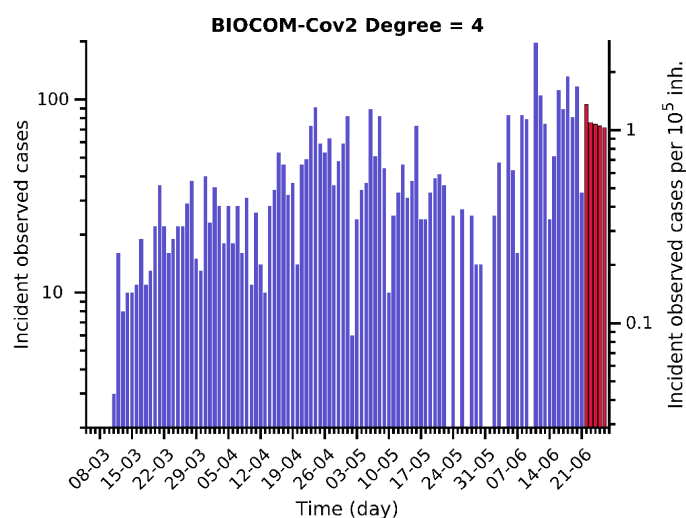
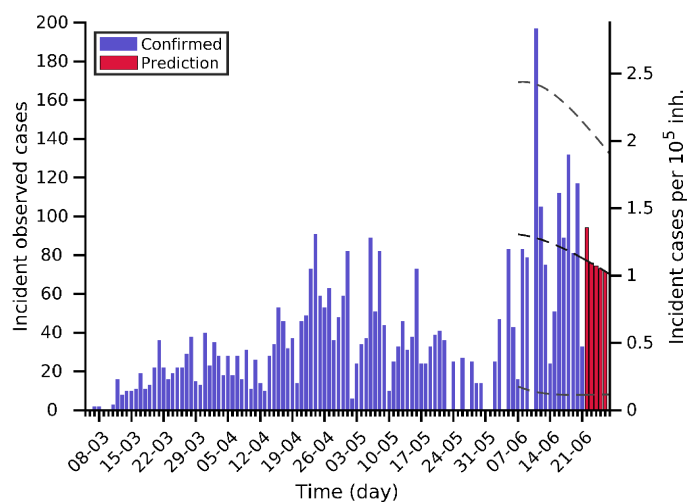
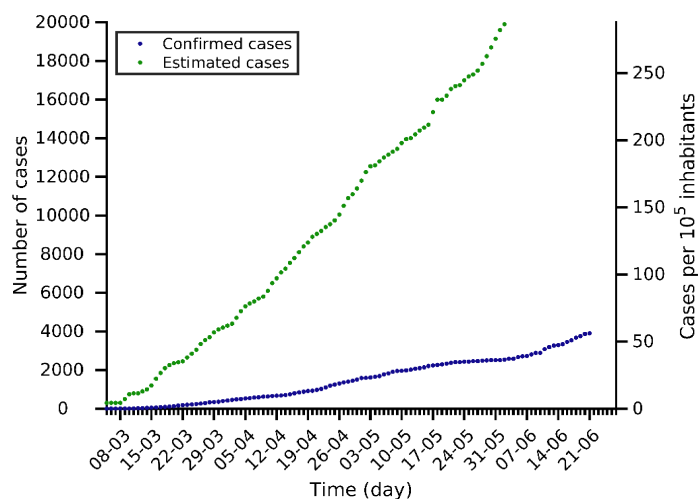
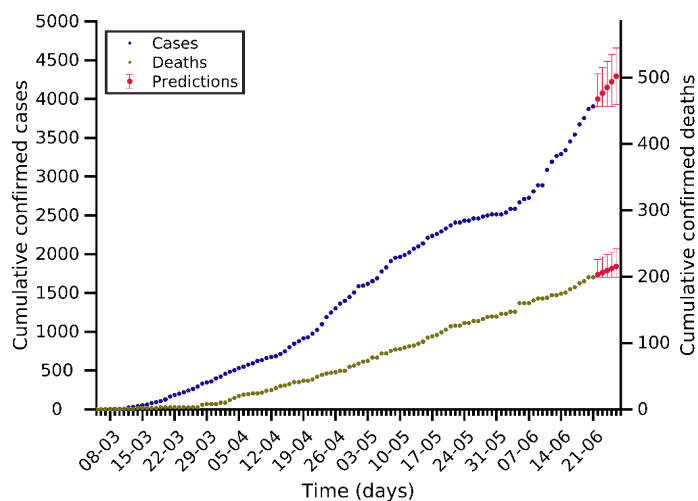
Luxembourg 21-06-2020. Population: 0.6M. Current cumulative incidence: 658/10⁵



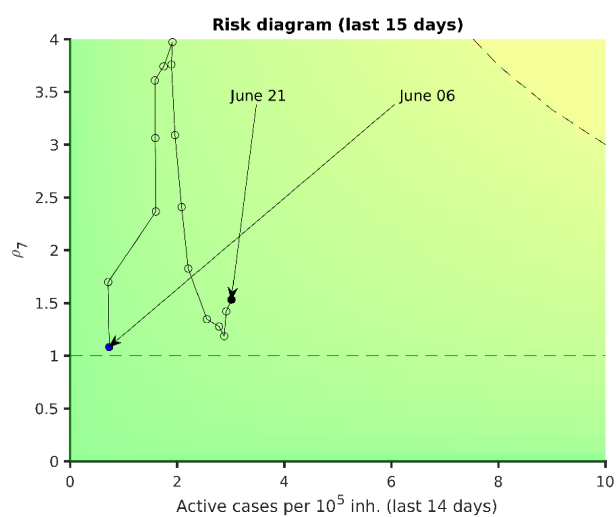
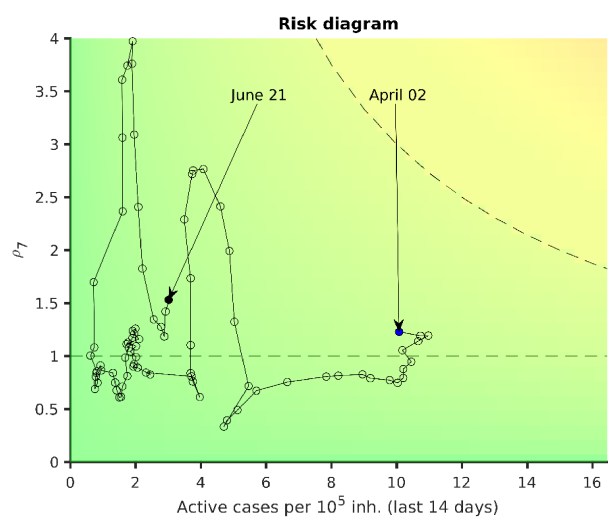
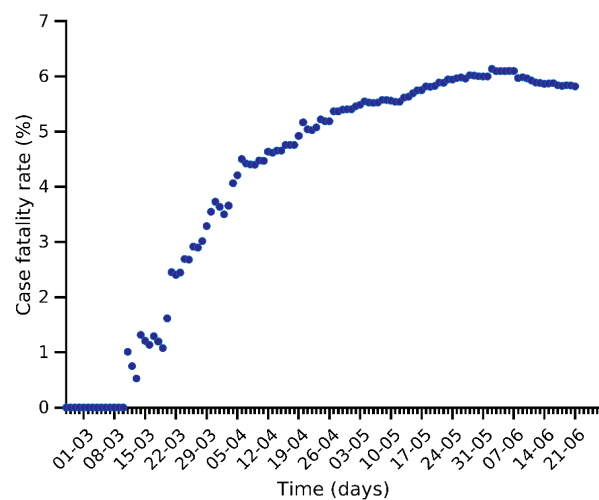
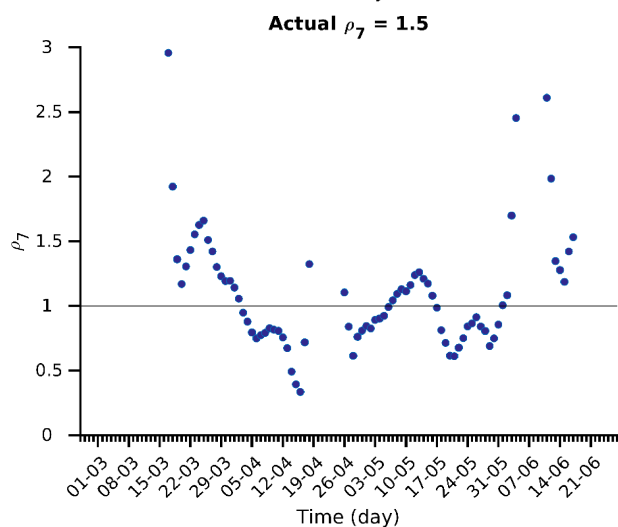
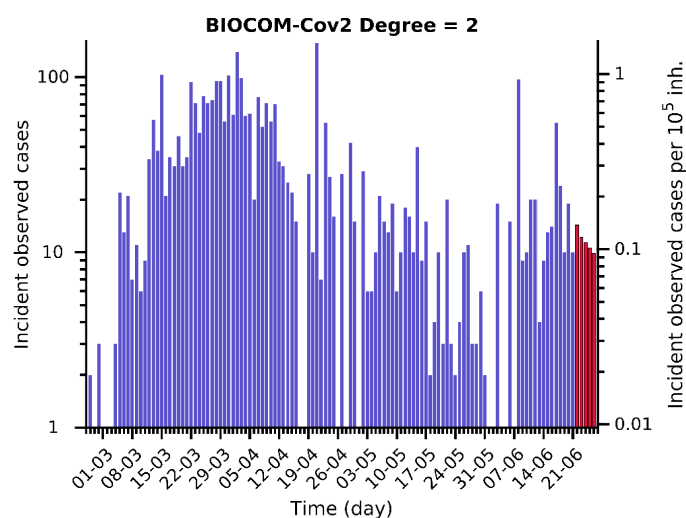
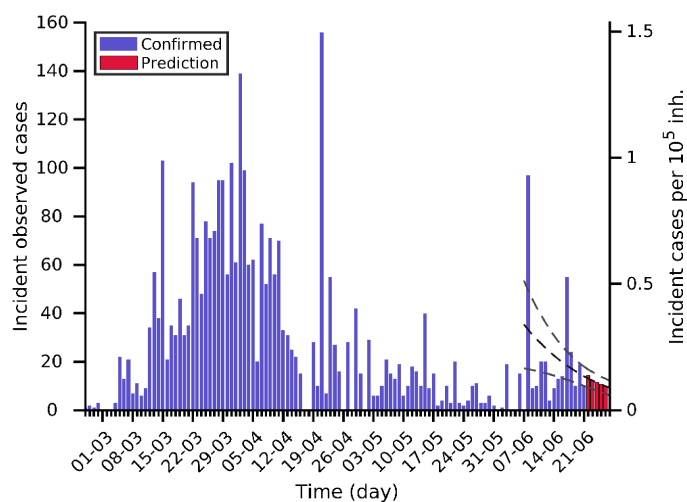
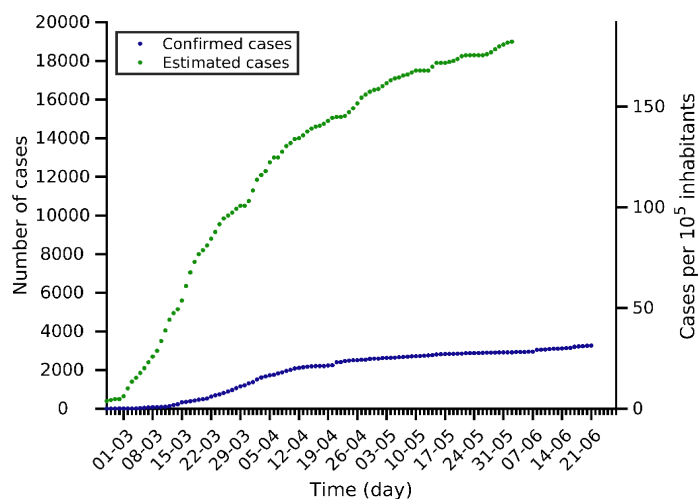
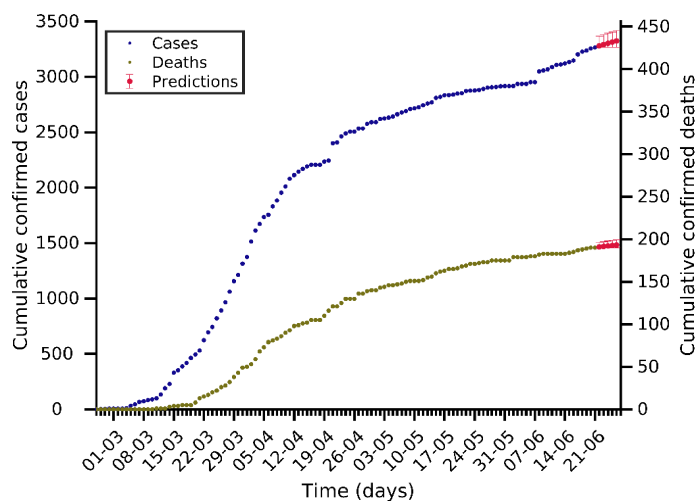
Hungary 21-06-2020. Population: 9.7M. Current cumulative incidence: 42/10⁵



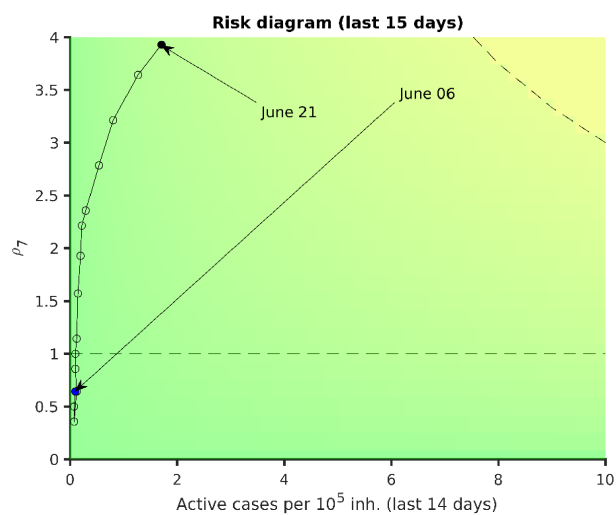
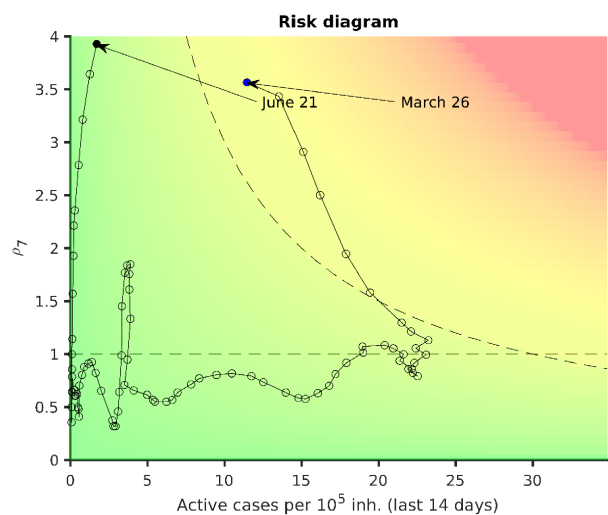
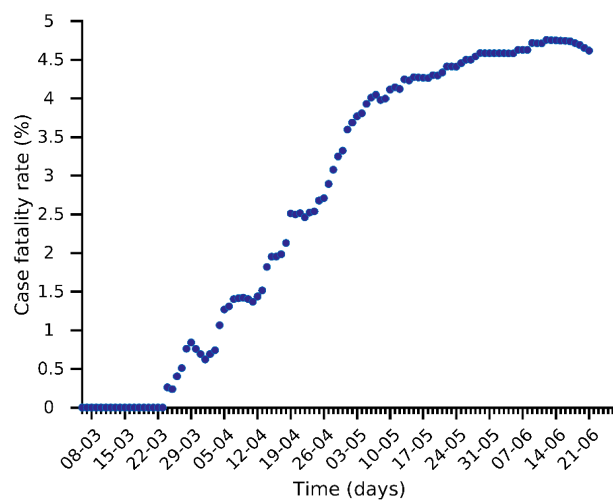
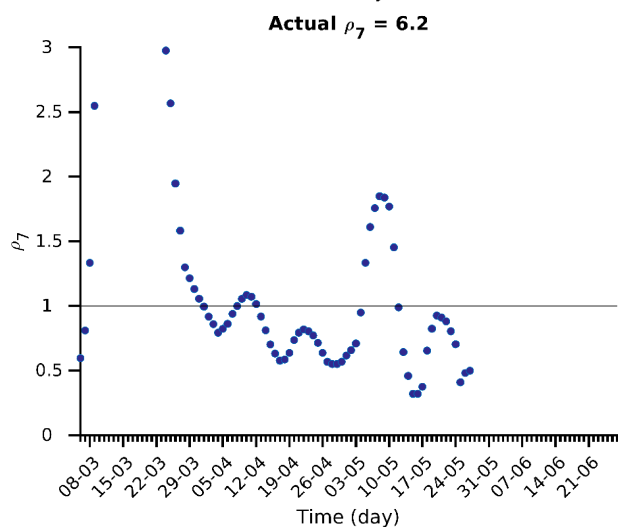
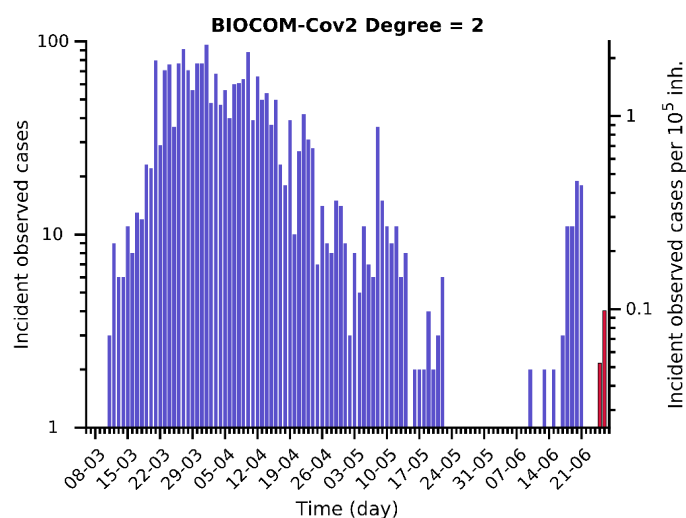
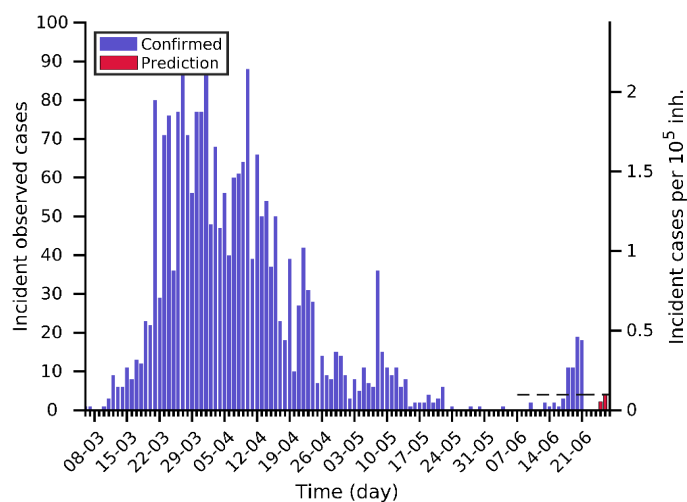
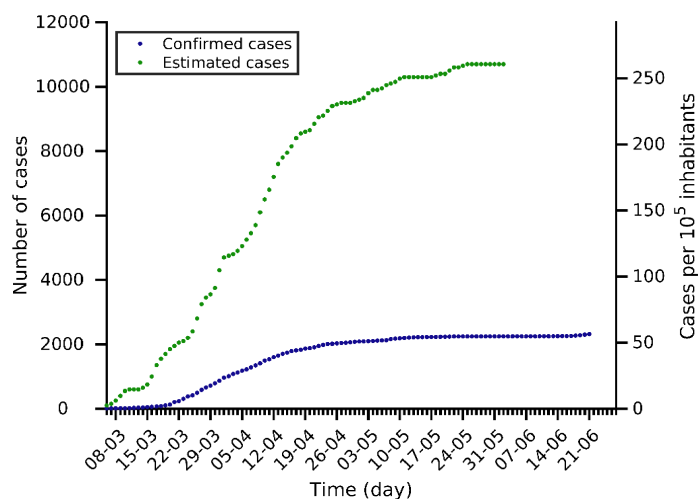
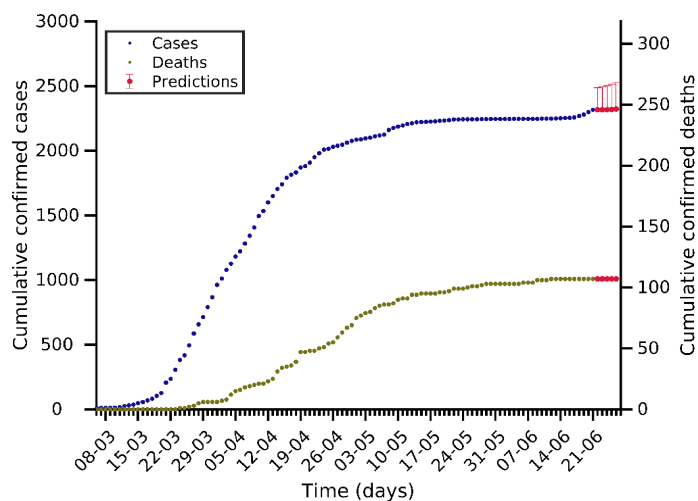
Bulgaria 21-06-2020. Population: 6.9M. Current cumulative incidence: 56/10⁵



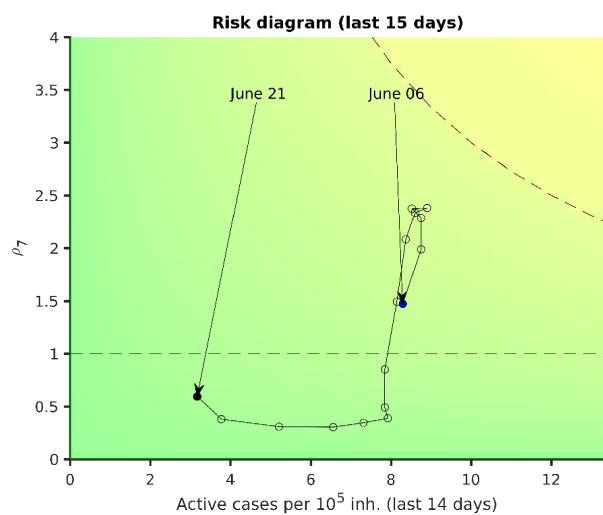
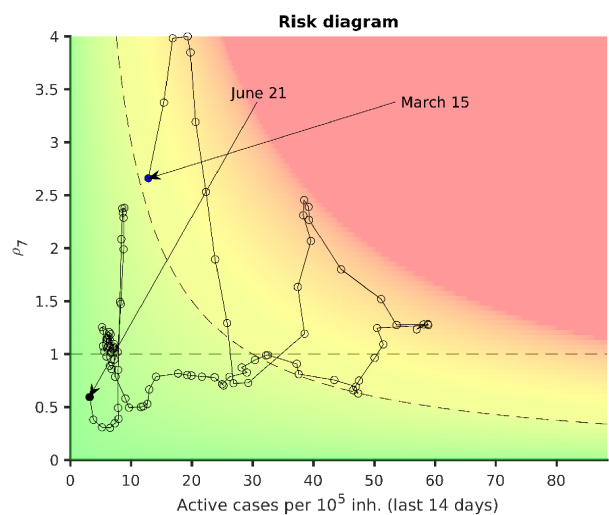
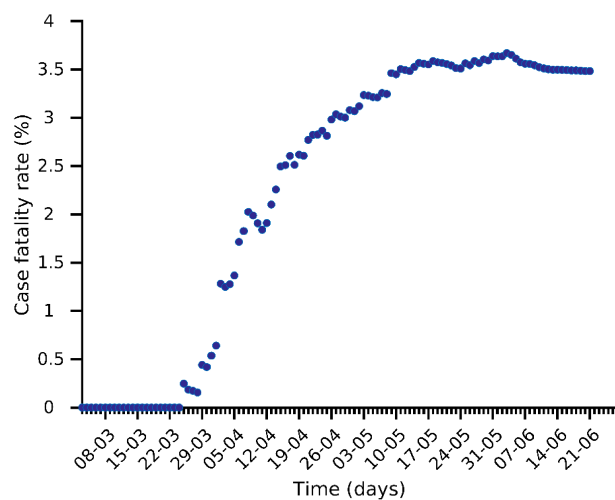
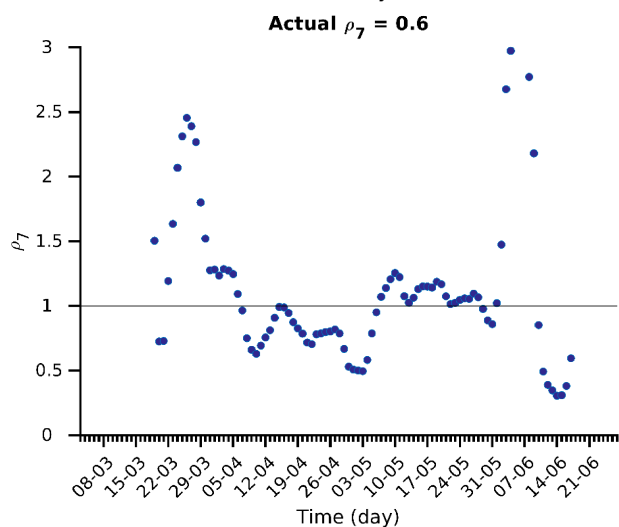
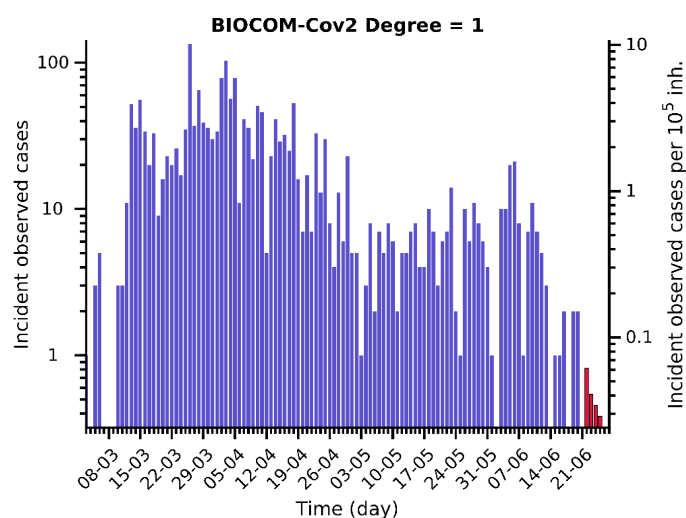
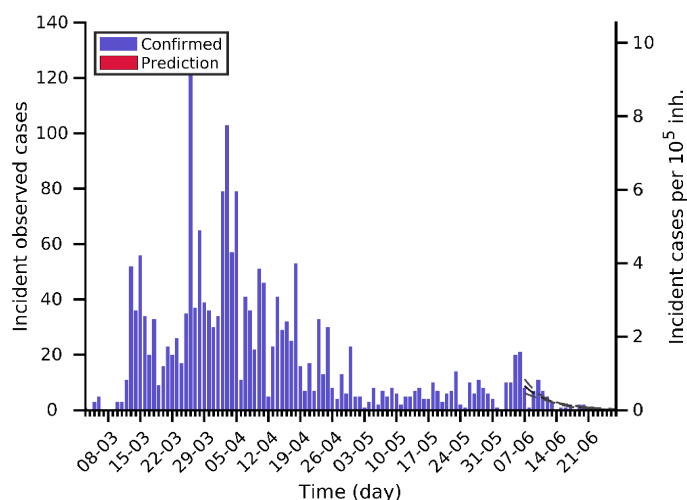
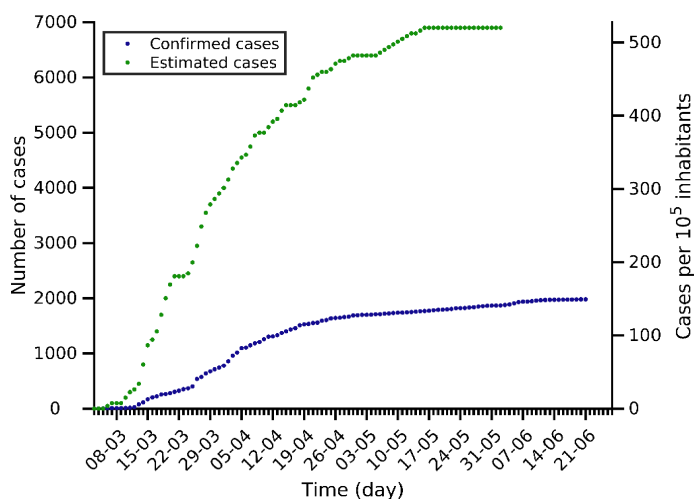
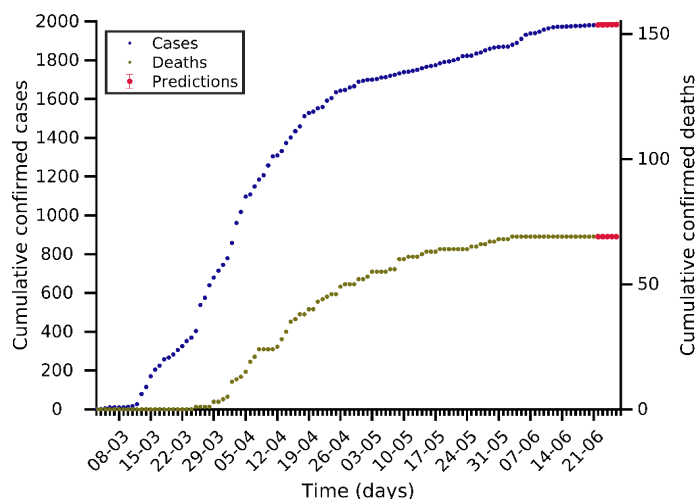
Greece 21-06-2020. Population: 10.4M. Current cumulative incidence: 31/10⁵



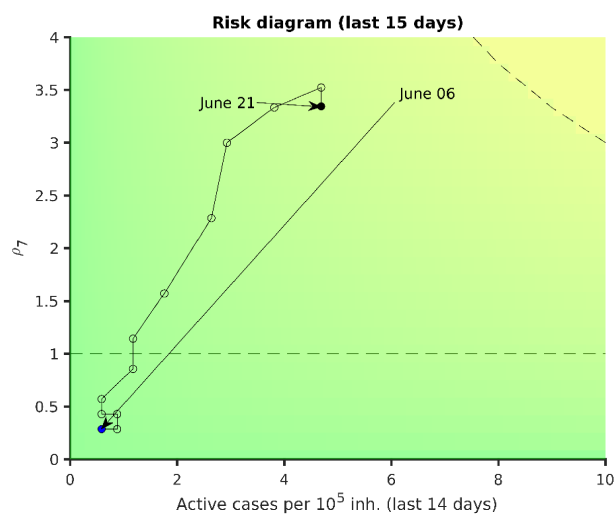
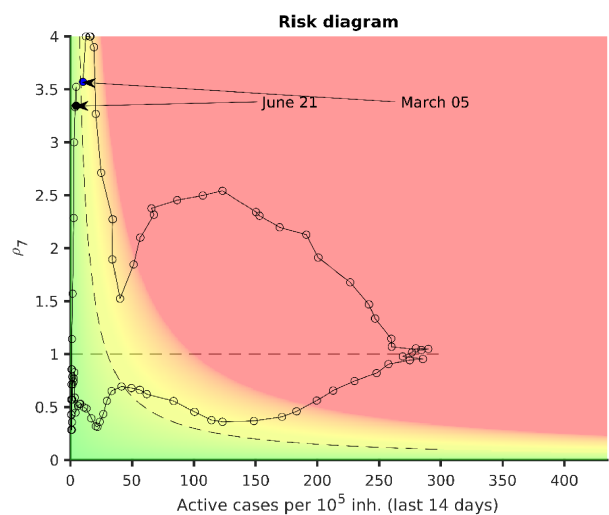
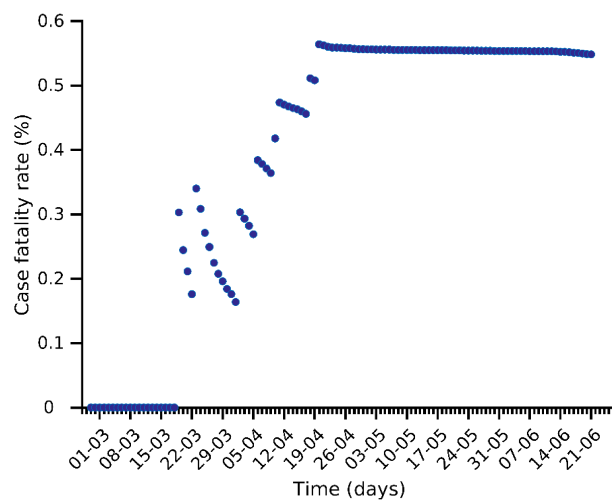
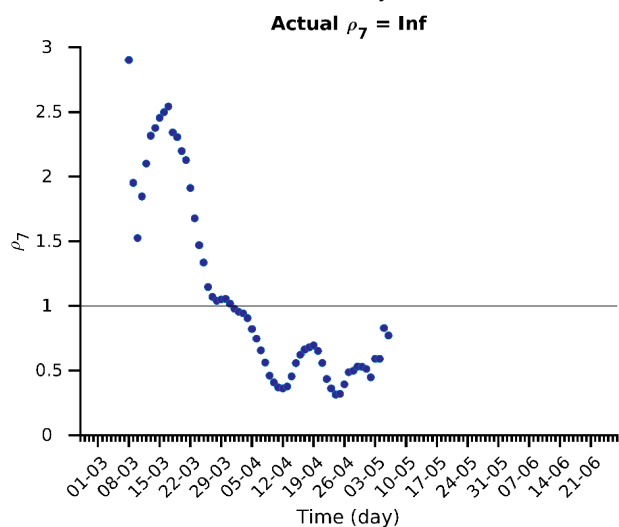
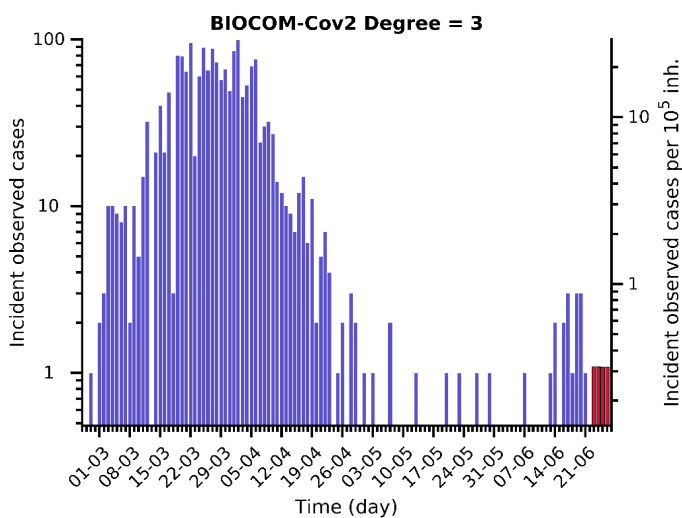
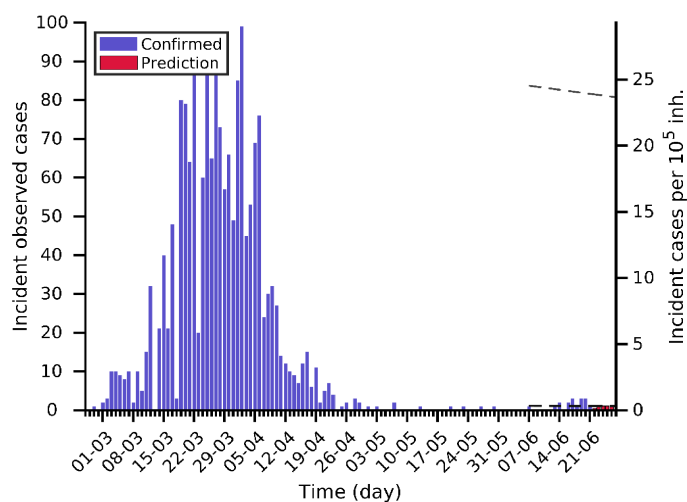
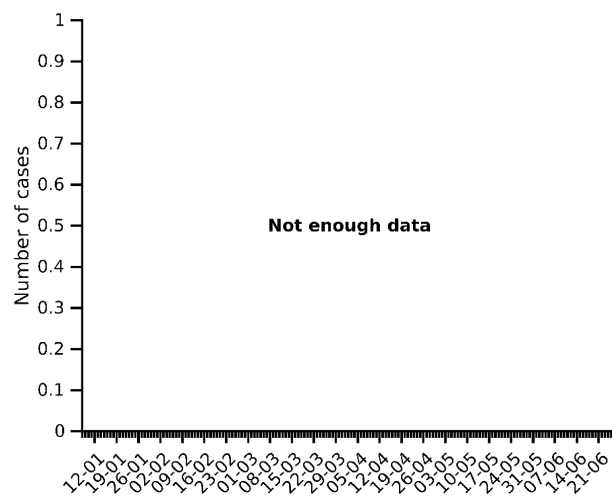
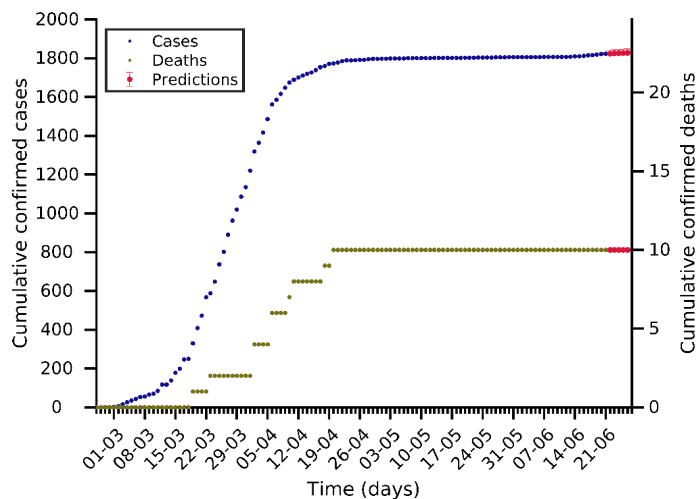
Croatia 21-06-2020. Population: 4.1M. Current cumulative incidence: 56/10⁵



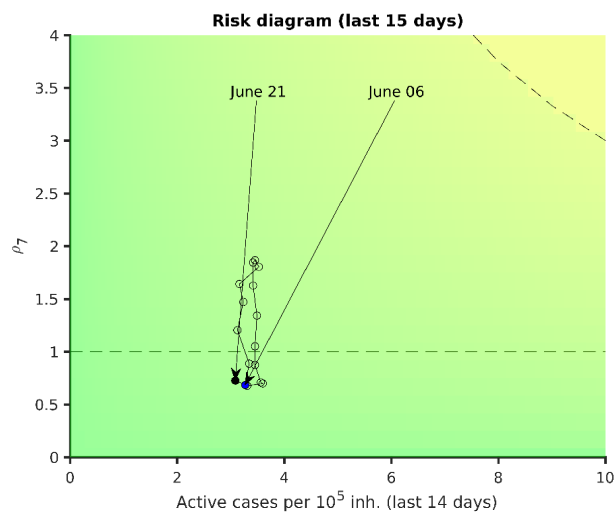
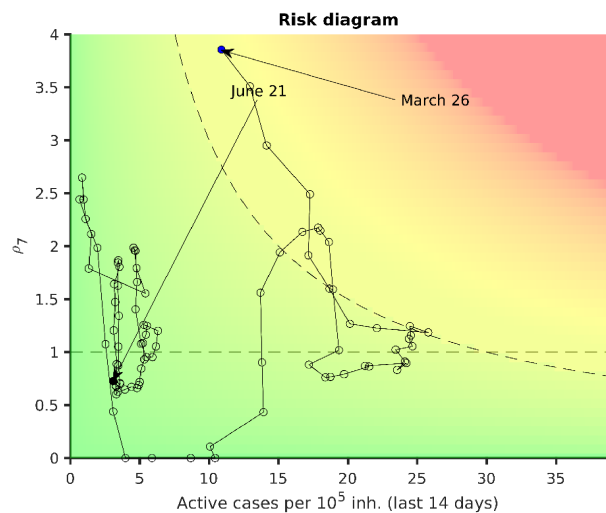
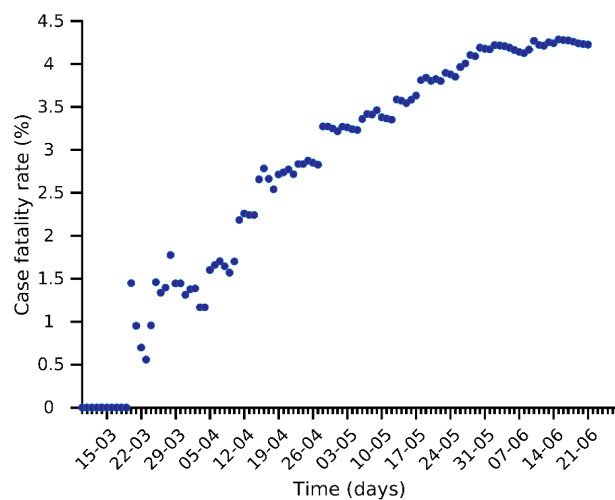
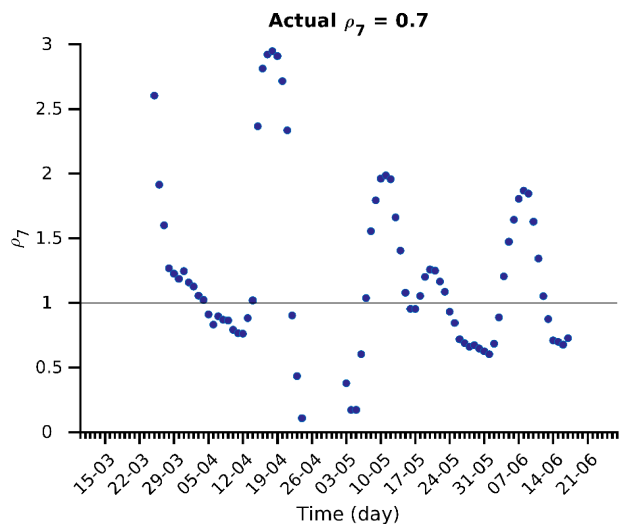
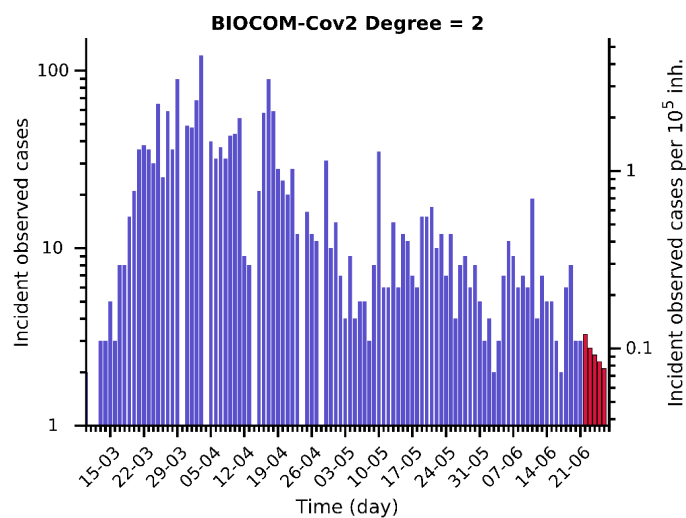
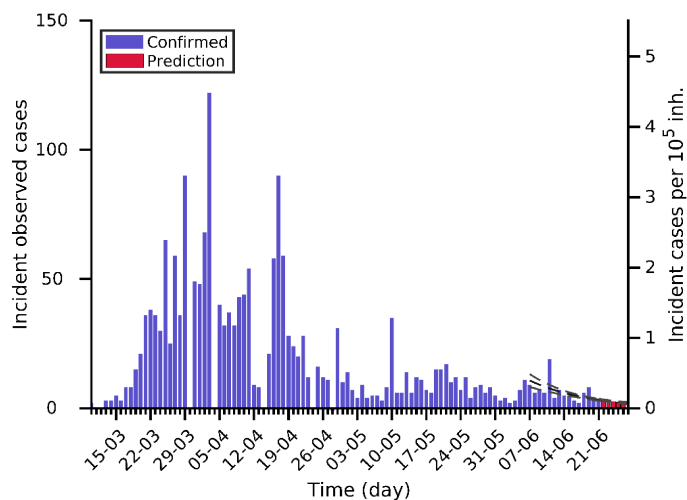
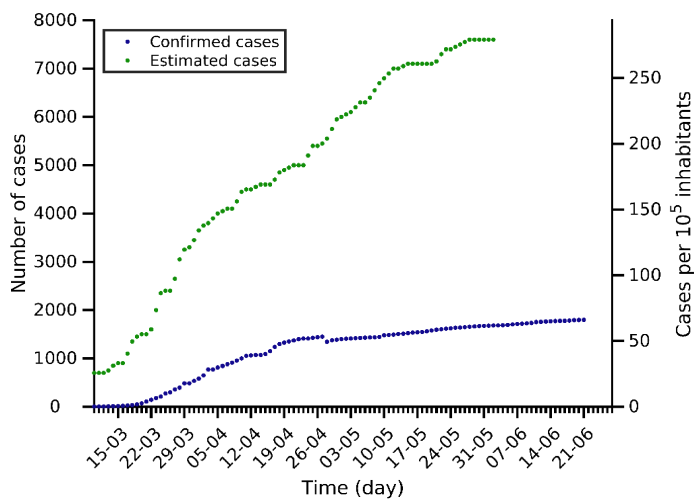
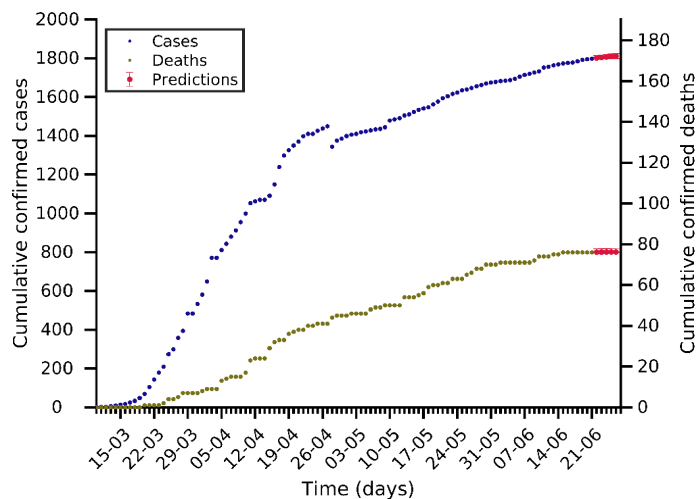
Estonia 21-06-2020. Population: 1.3M. Current cumulative incidence: 149/10⁵



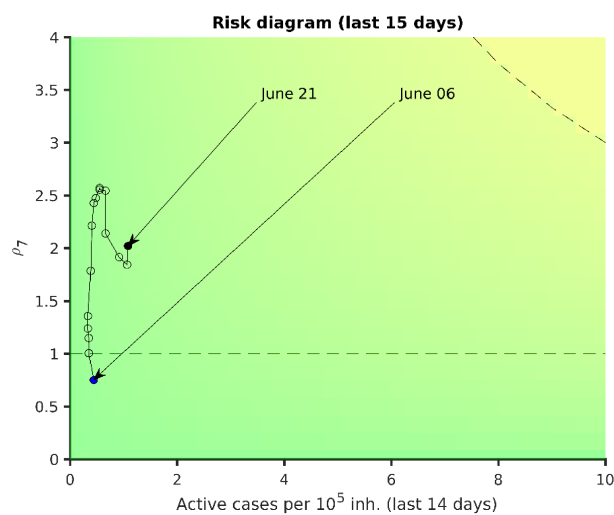
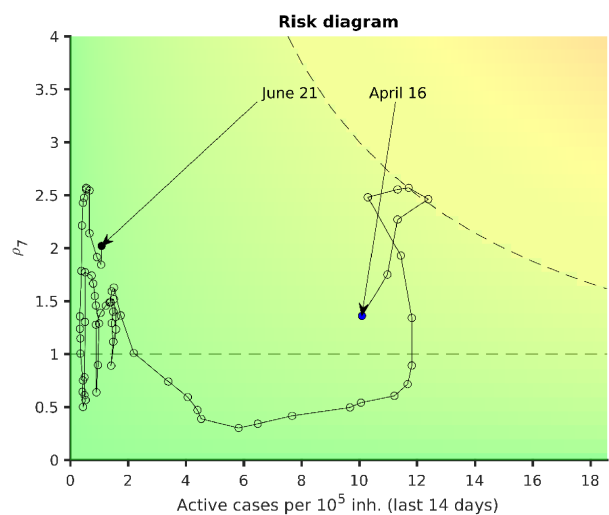
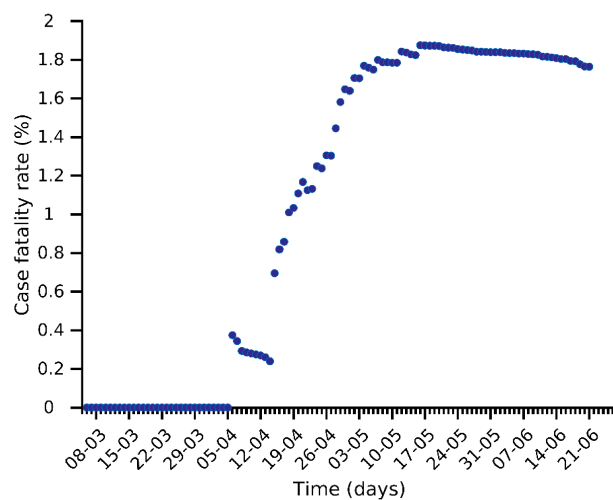
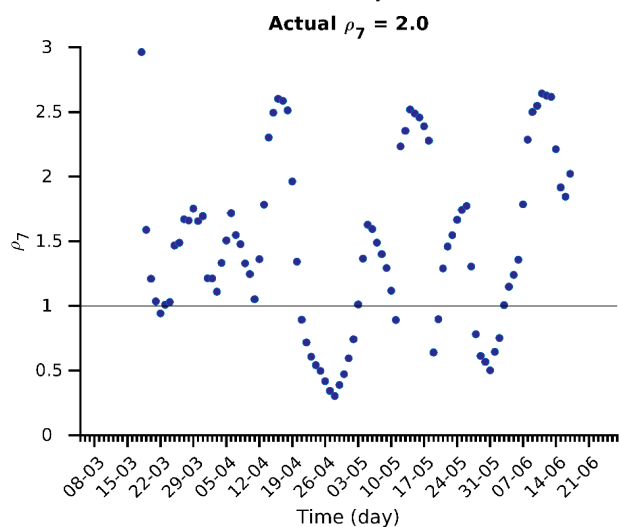
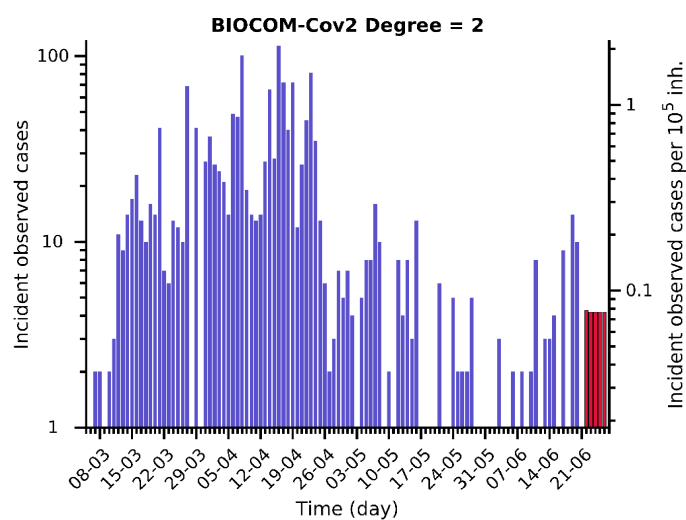
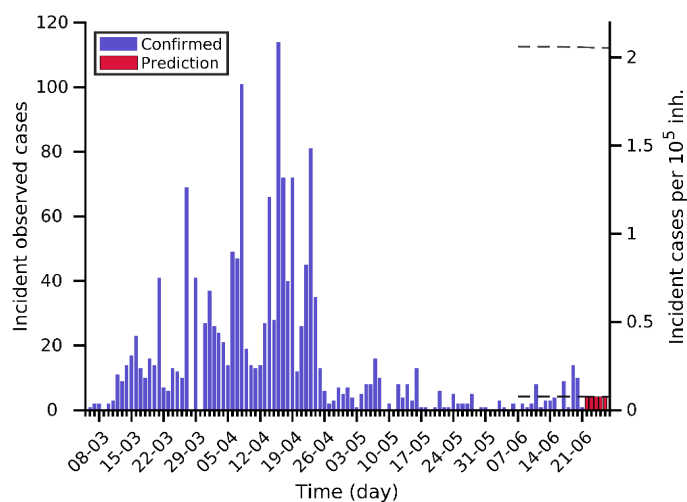
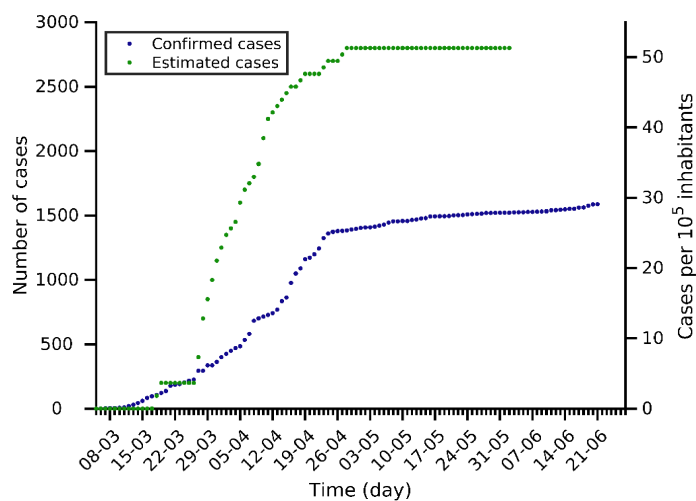
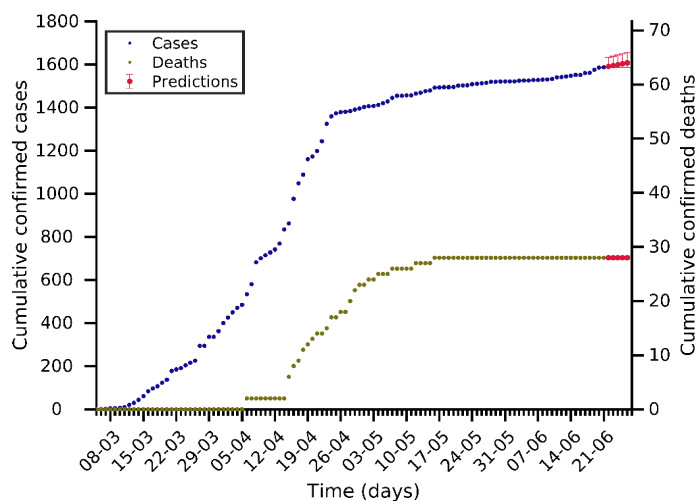
Iceland 21-06-2020. Population: 0.3M. Current cumulative incidence: 534/10⁵



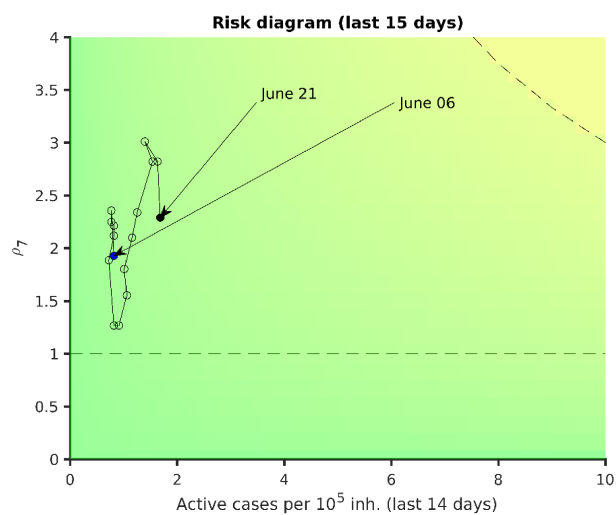
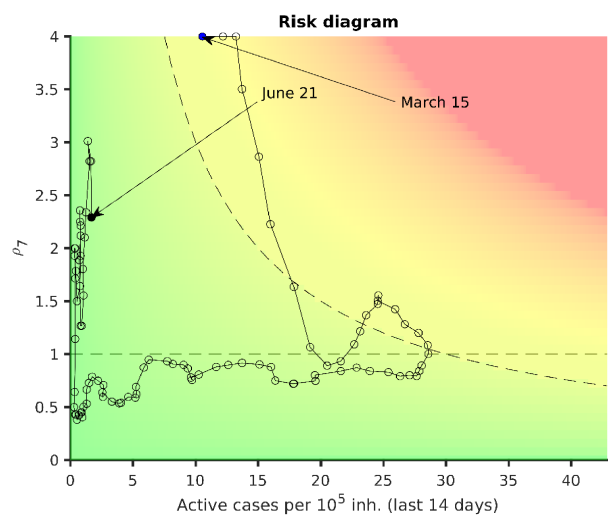
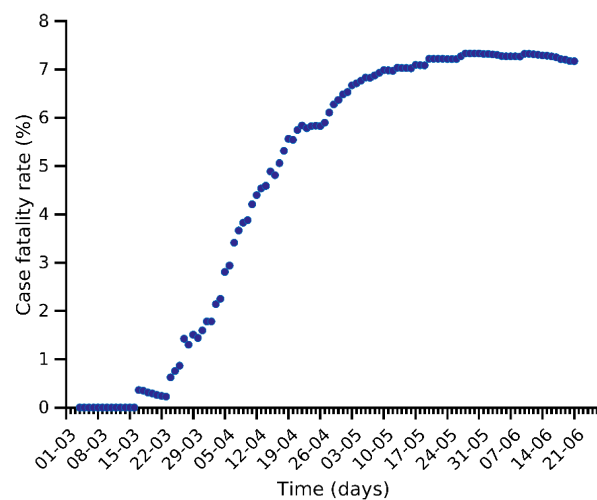
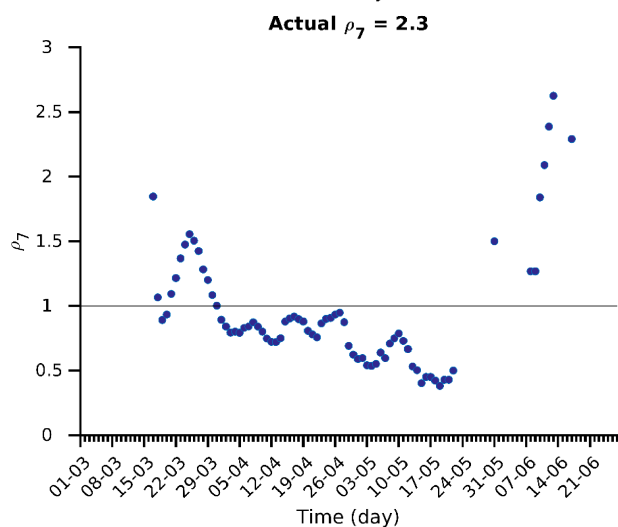
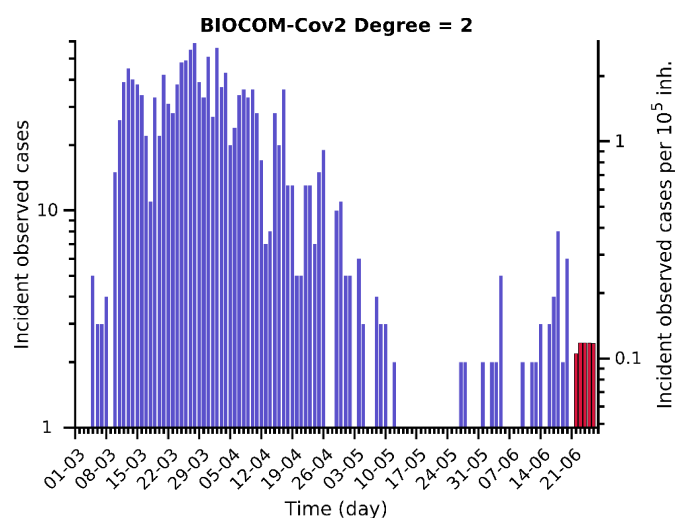
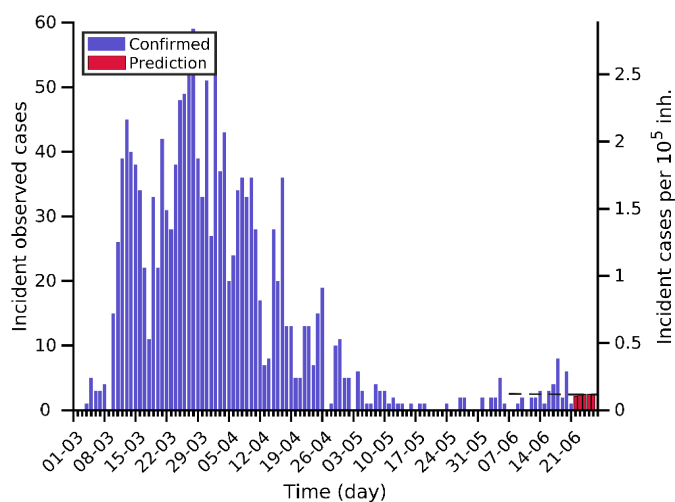
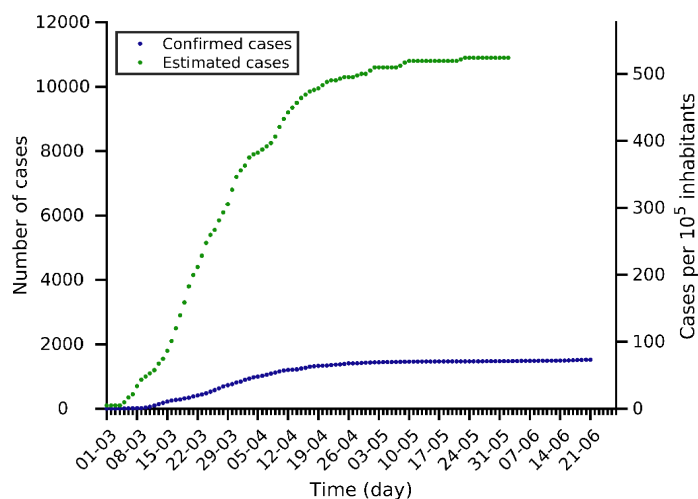
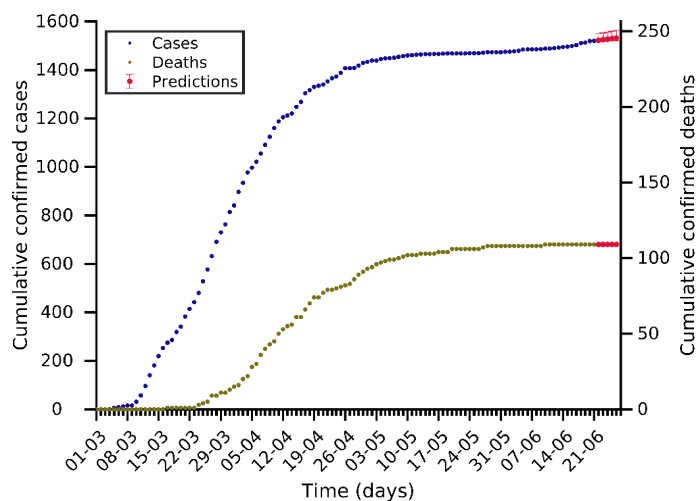
Lithuania 21-06-2020. Population: 2.7M. Current cumulative incidence: 66/10⁵



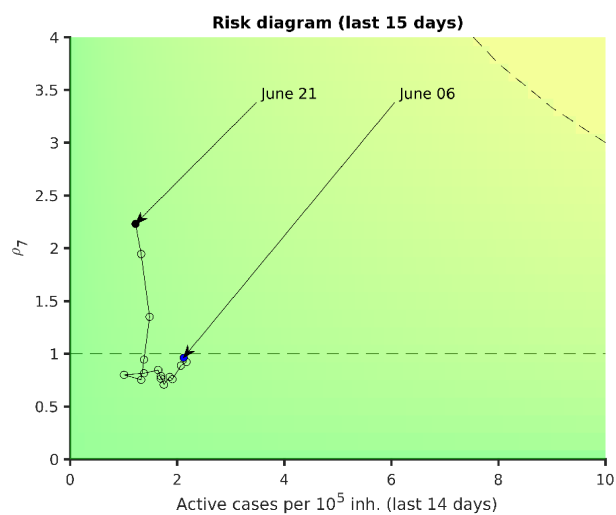
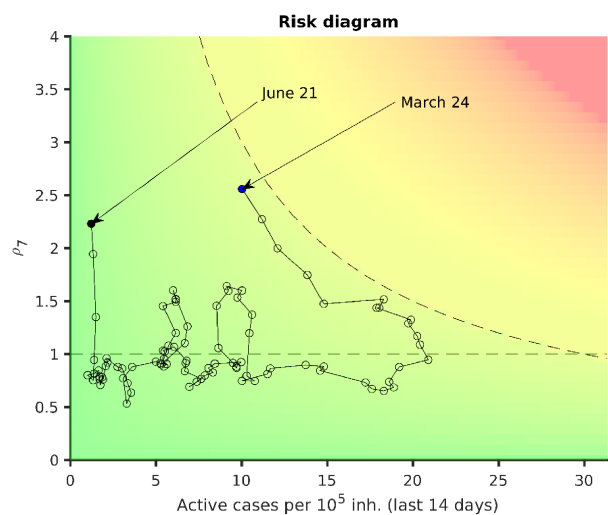
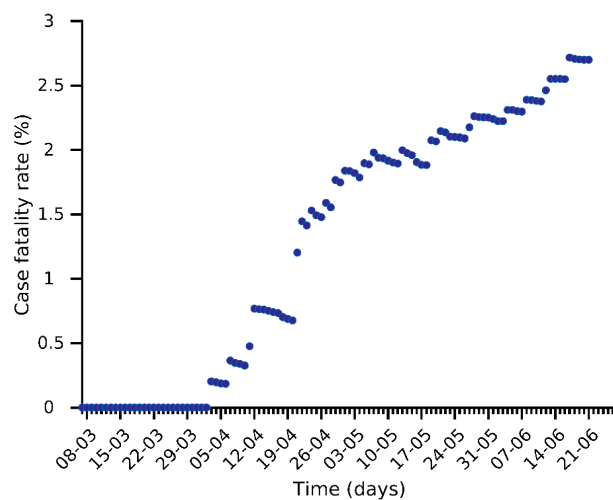
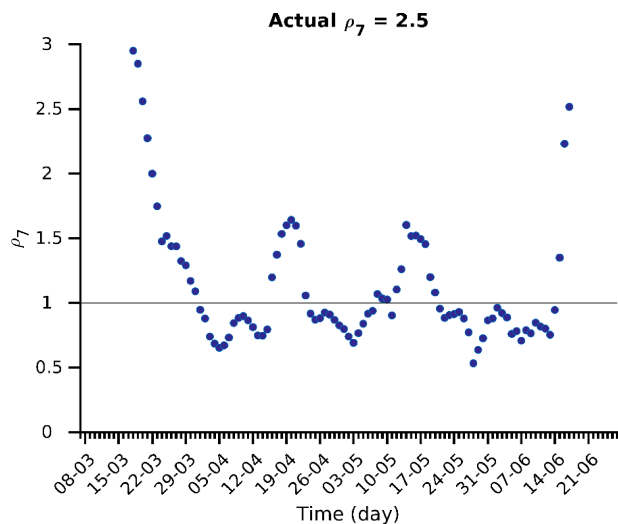
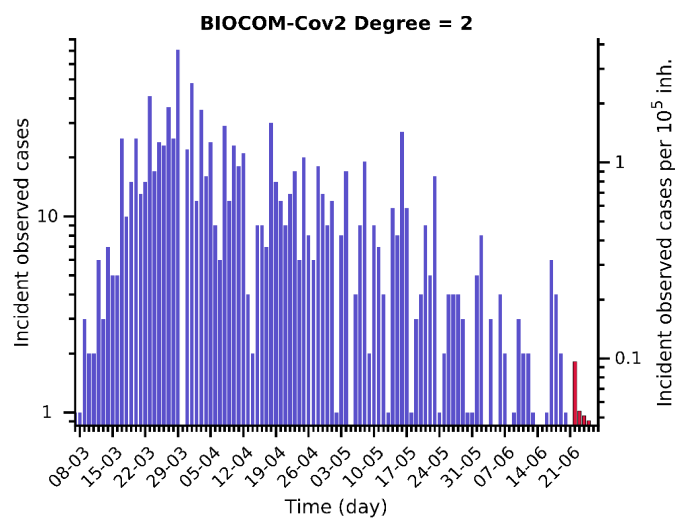
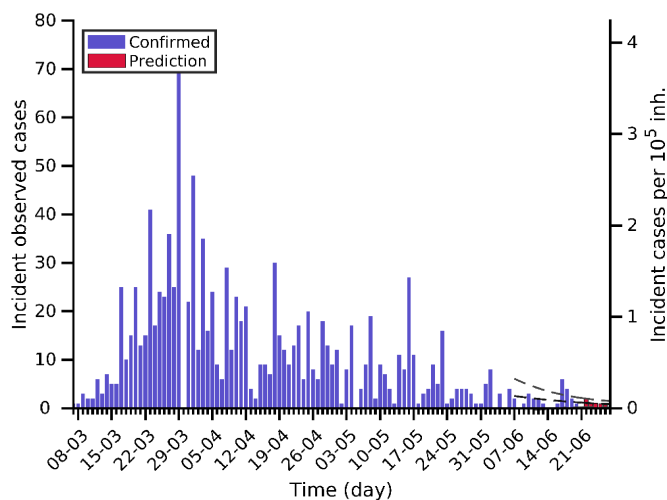
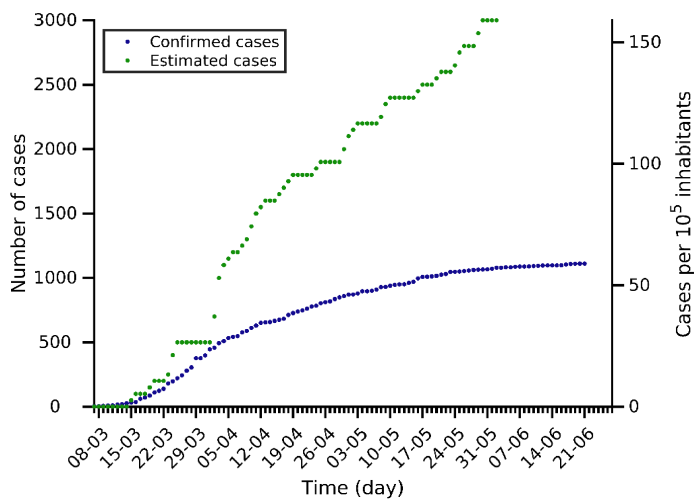
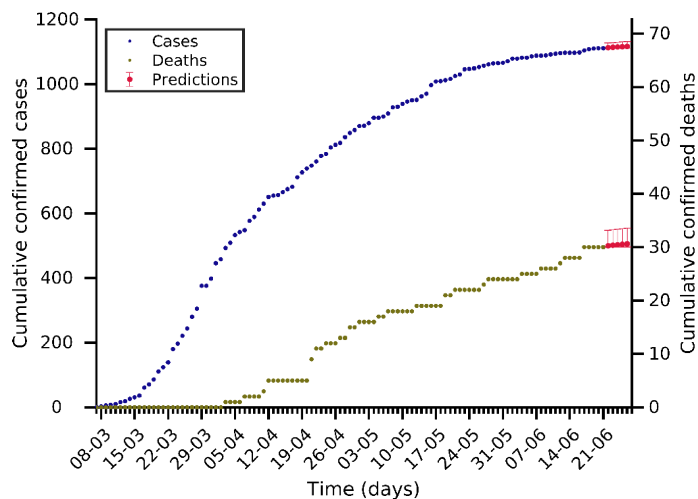
Slovakia 21-06-2020. Population: 5.5M. Current cumulative incidence: 29/10⁵



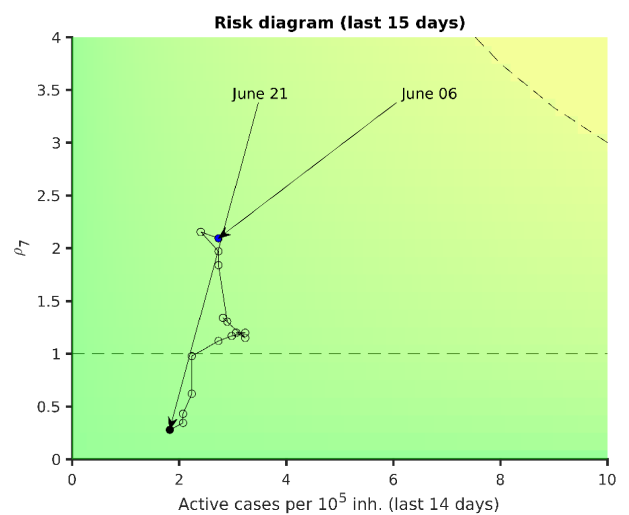
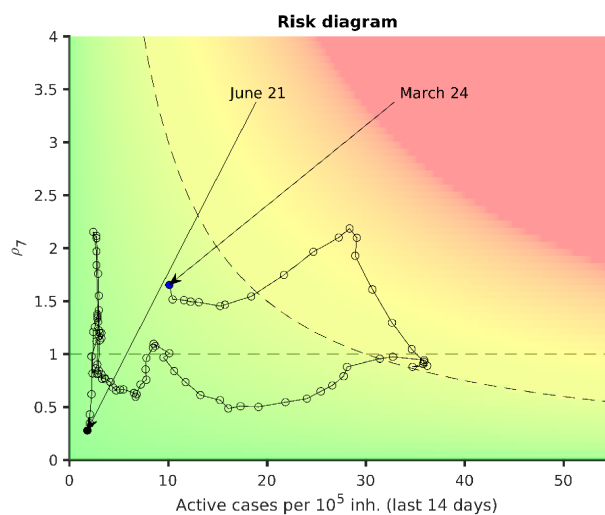
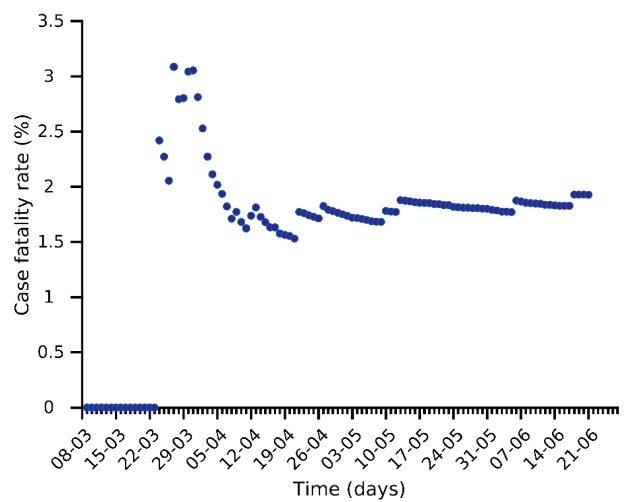
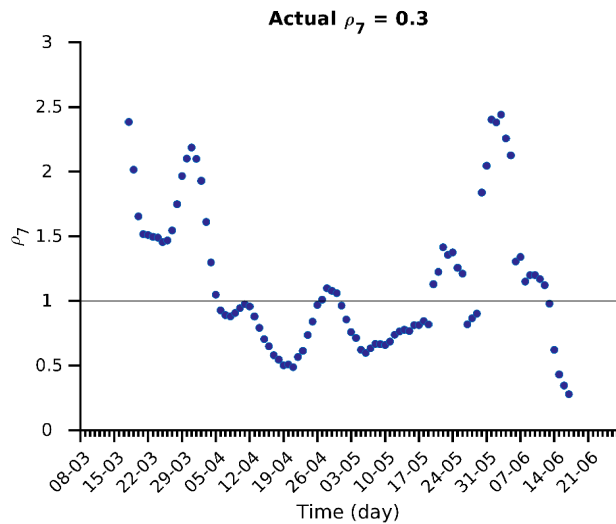
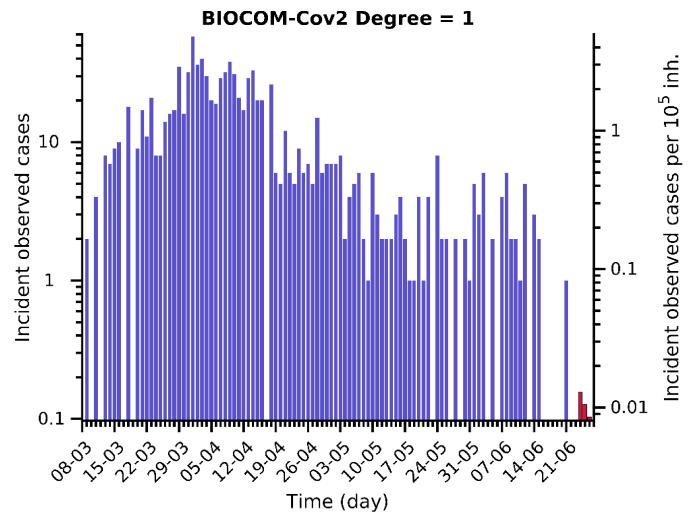
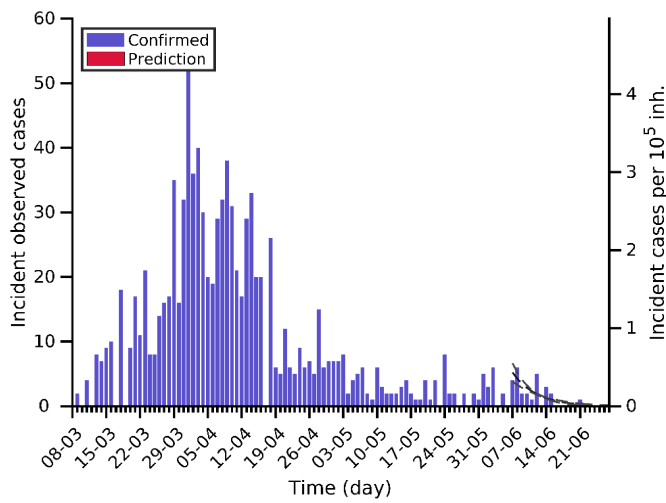
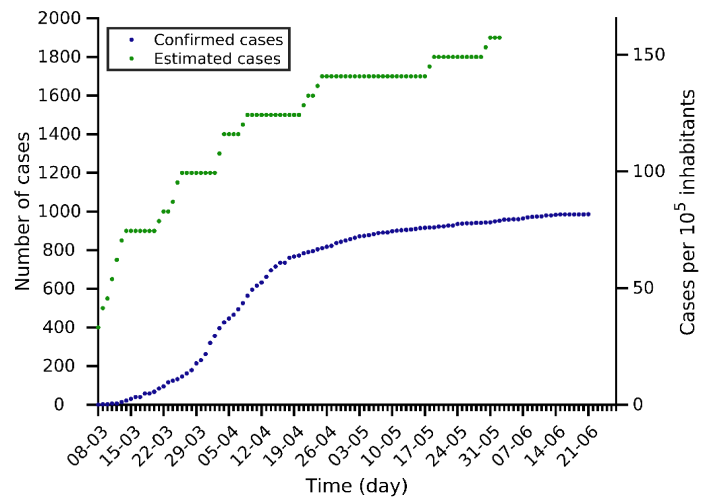
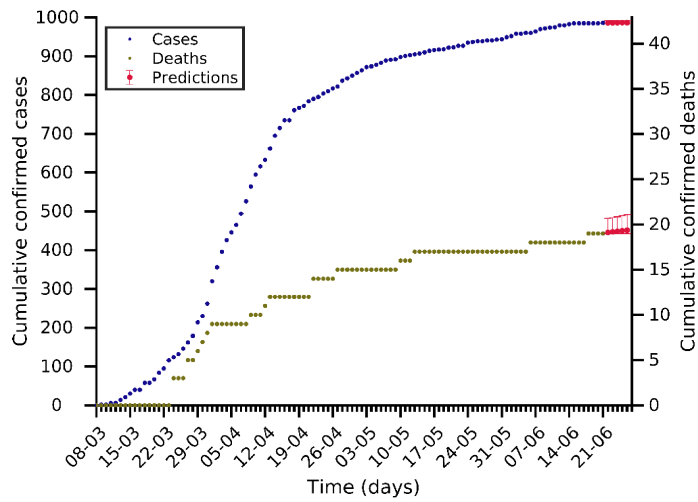
Slovenia 21-06-2020. Population: 2.1M. Current cumulative incidence: 73/10⁵



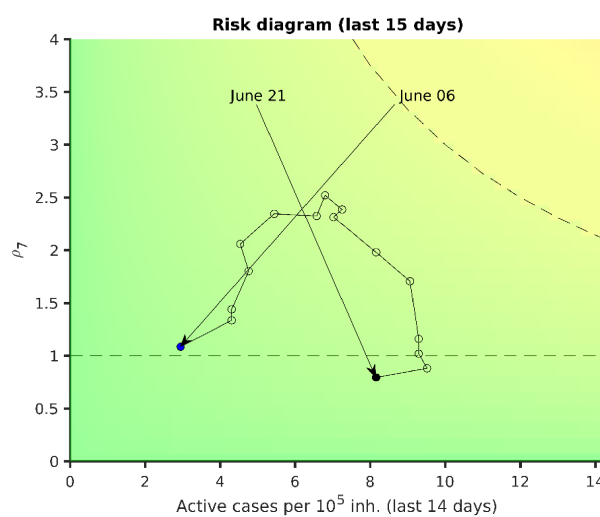
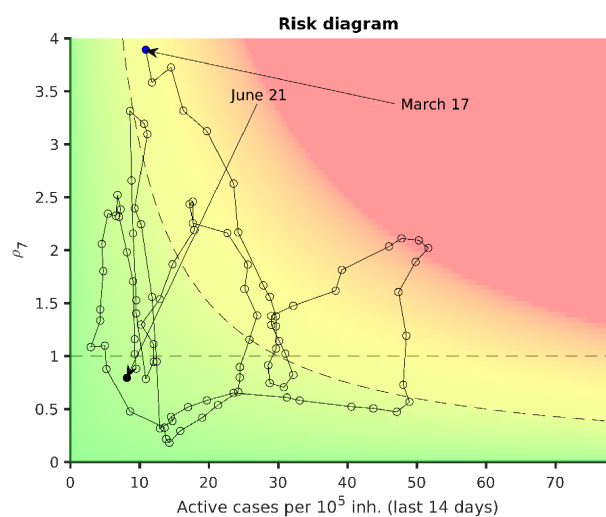
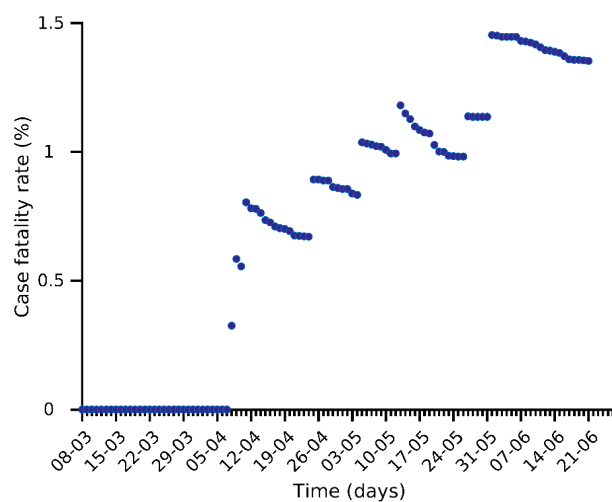
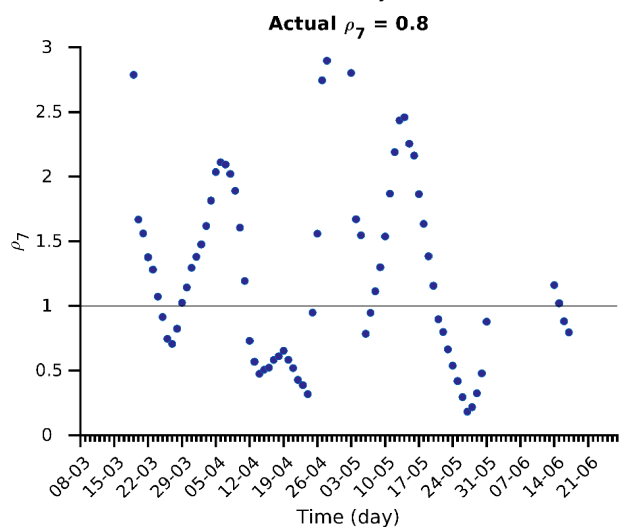
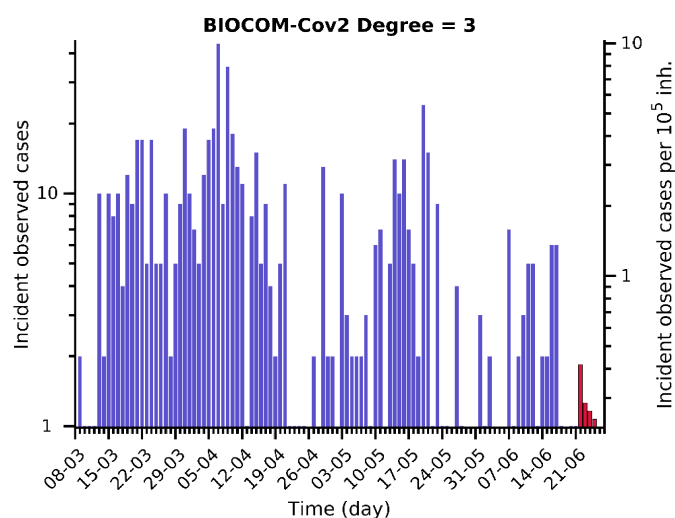
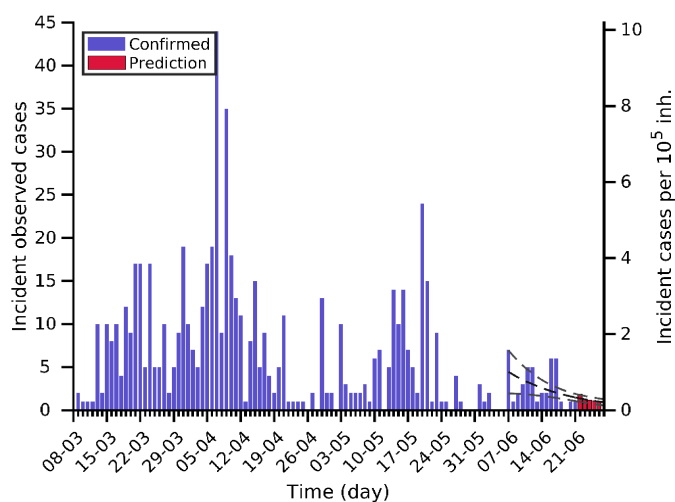
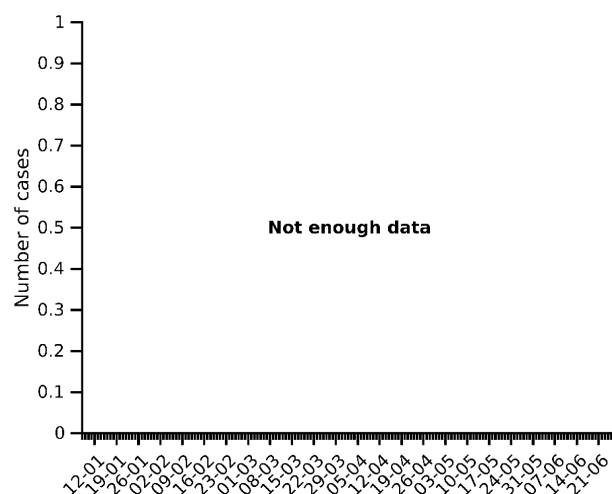
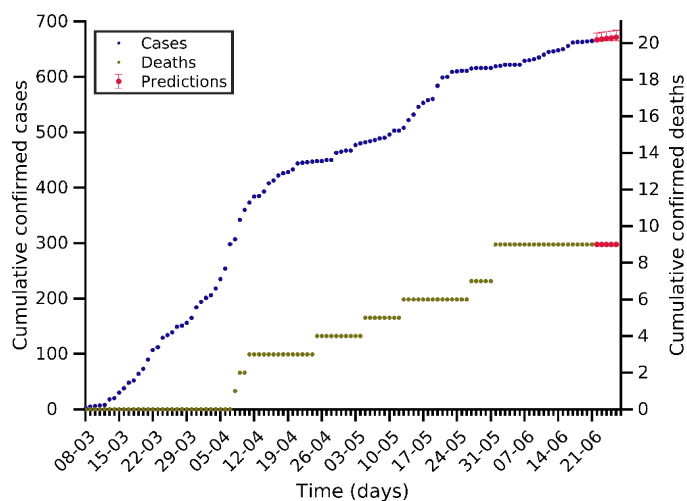
Latvia 21-06-2020. Population: 1.9M. Current cumulative incidence: 59/10⁵



Cyprus 21-06-2020. Population: 1.2M. Current cumulative incidence: 82/10⁵



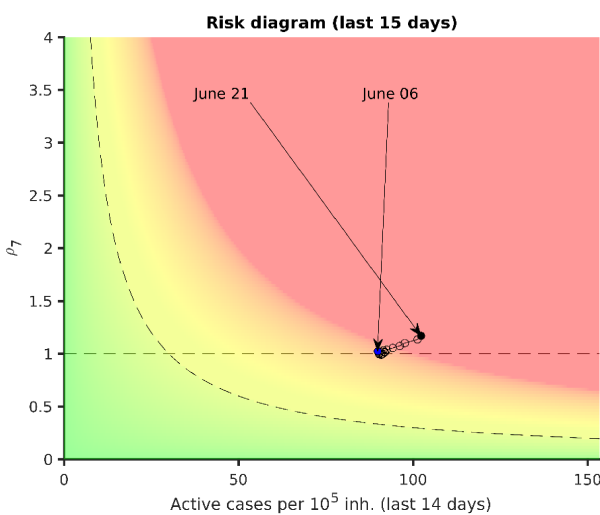
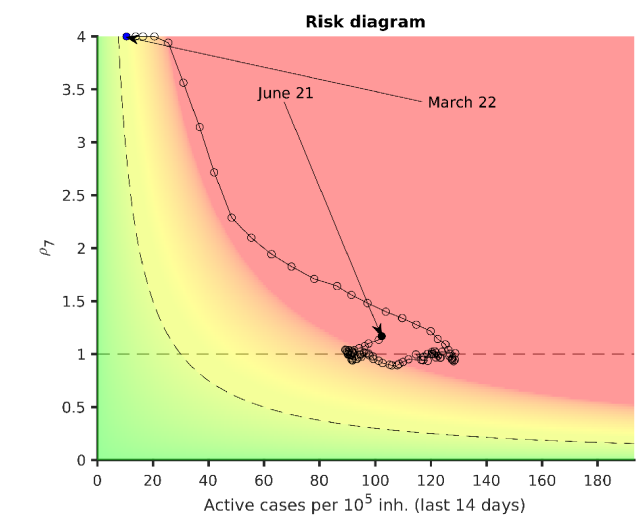
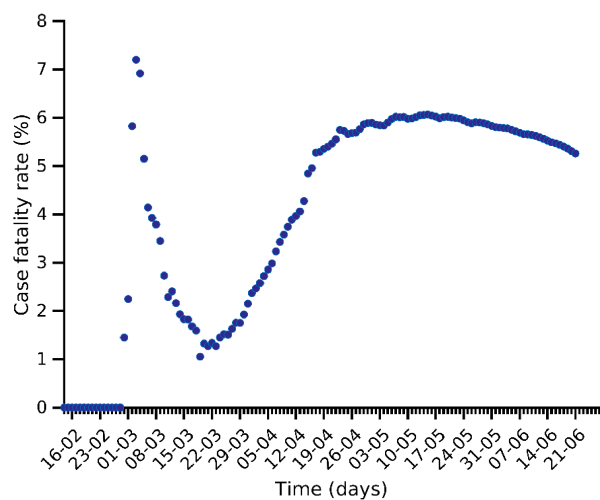
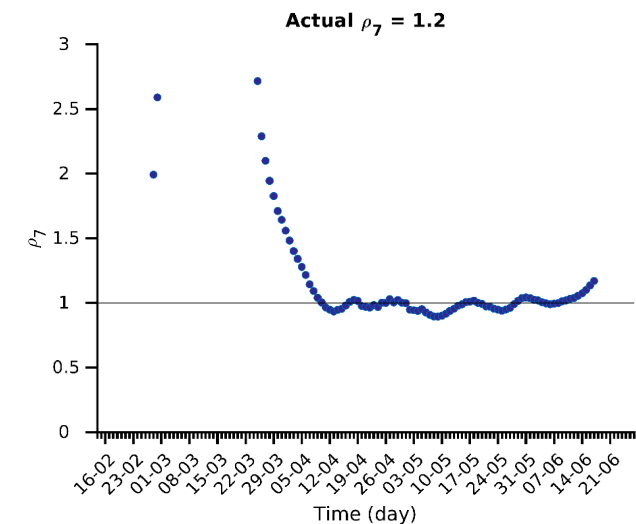
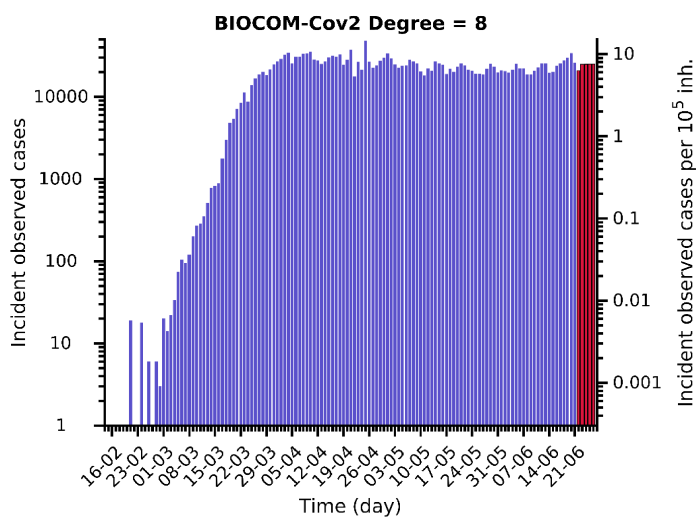
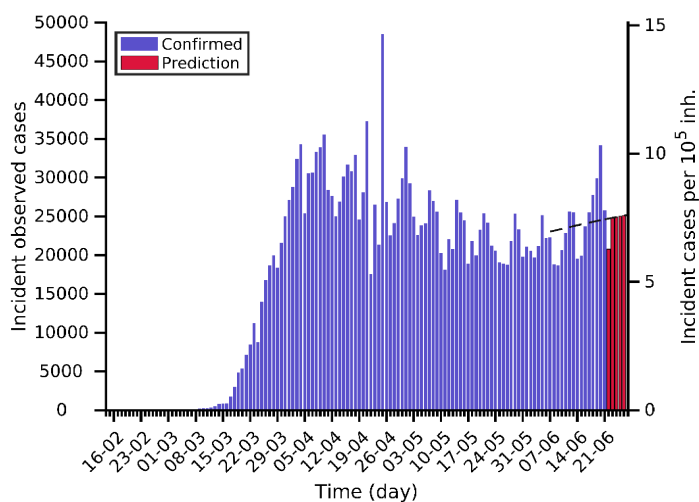
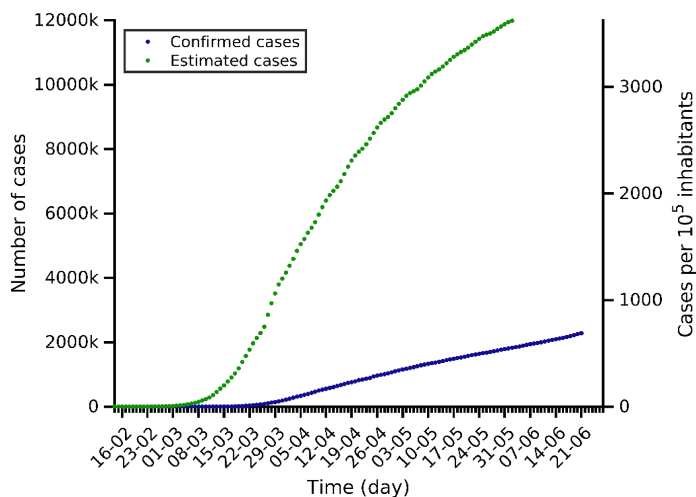
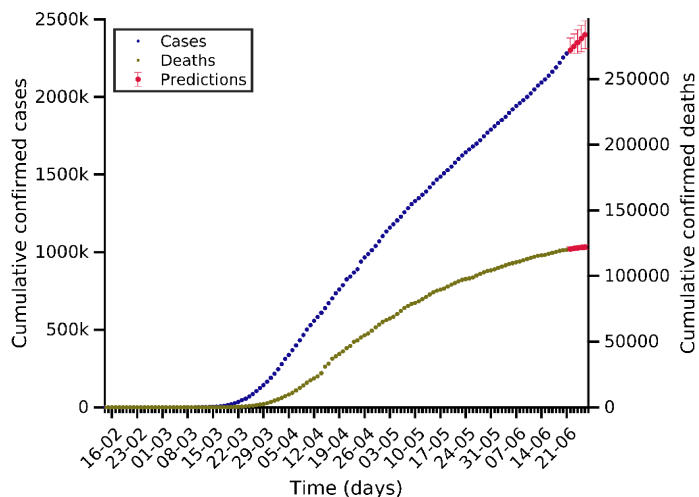
Malta 21-06-2020. Population: 0.4M. Current cumulative incidence: 151/10⁵



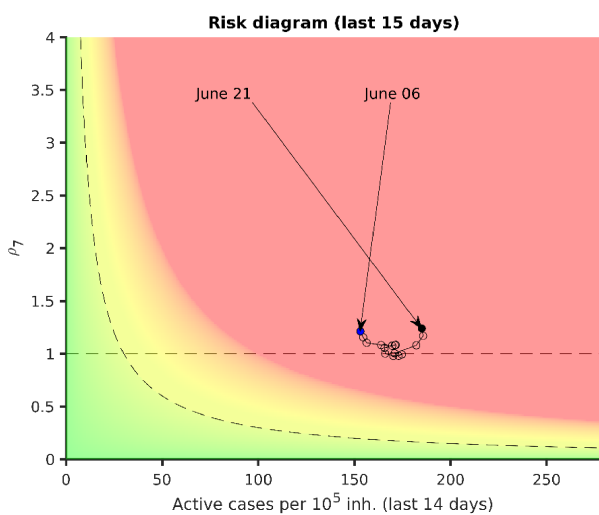
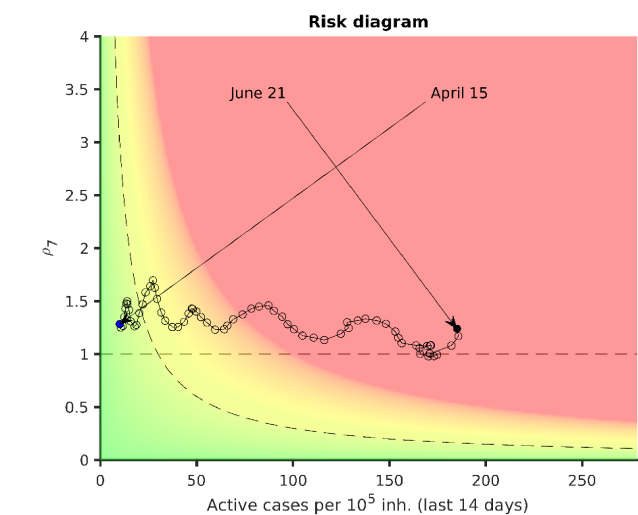
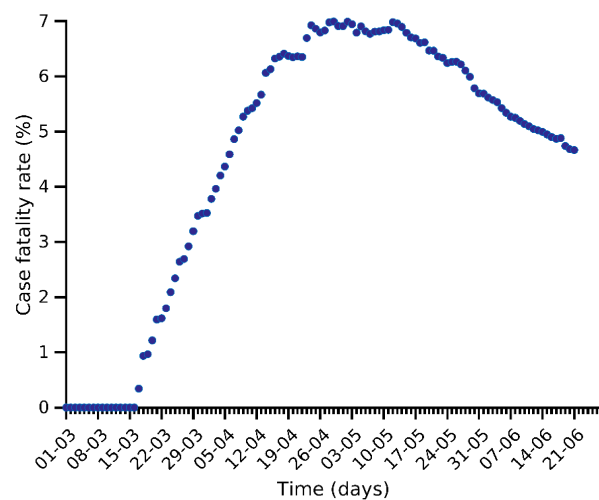
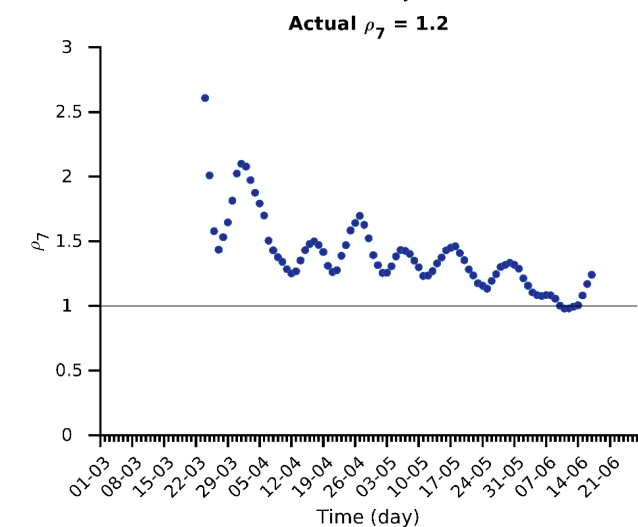
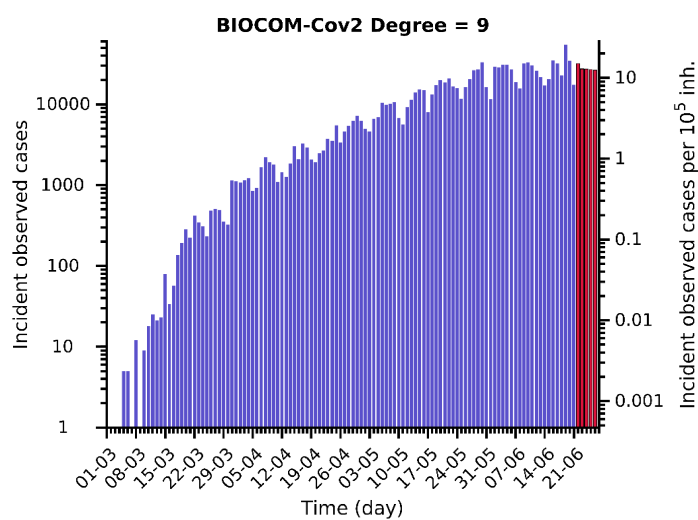
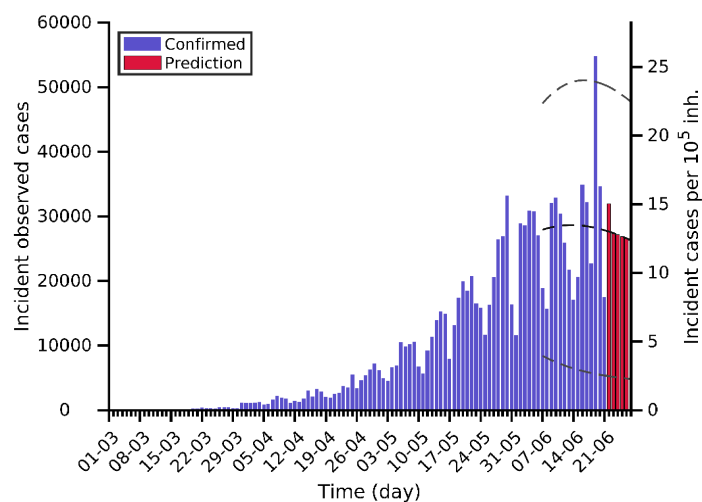
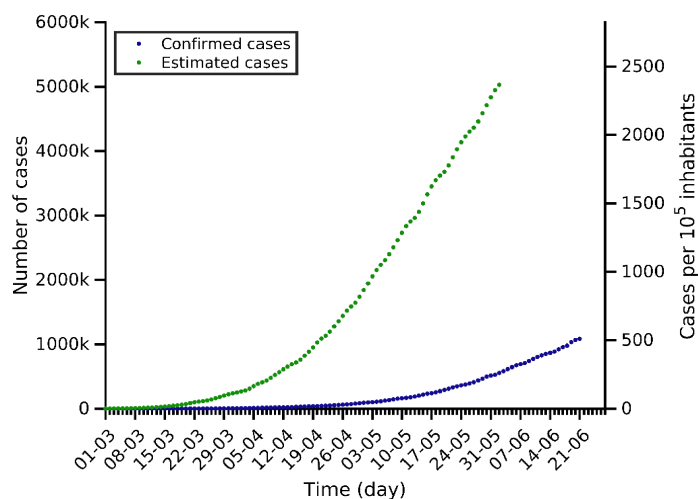
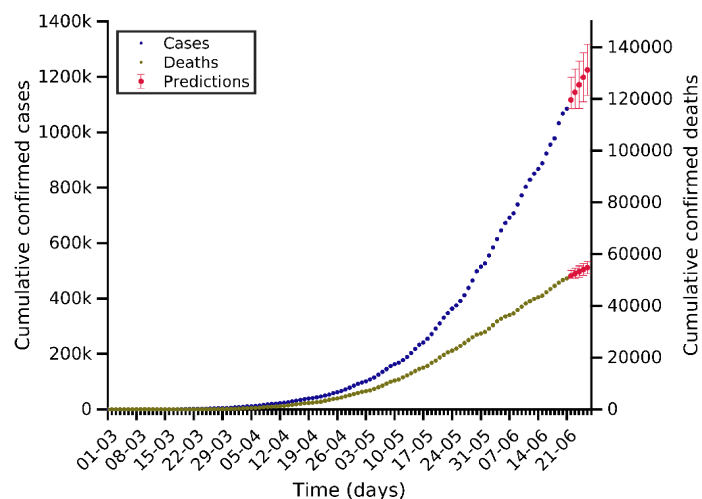
(2) Analysis and prediction of COVID-19 for other countries

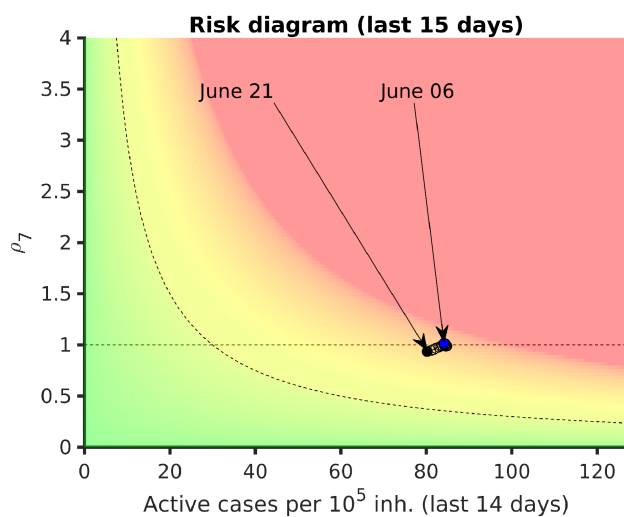
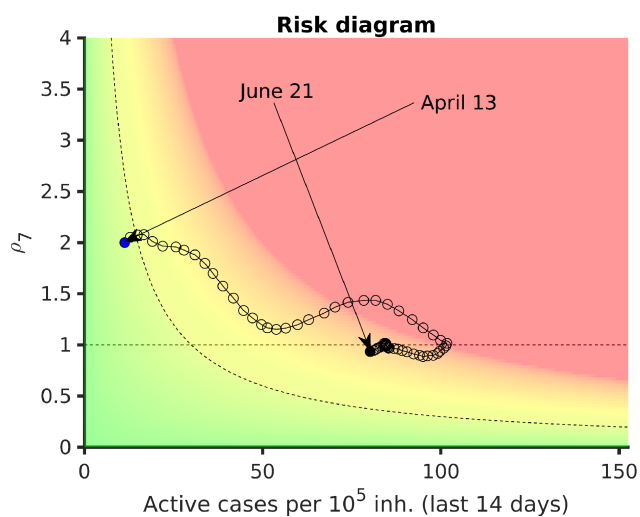
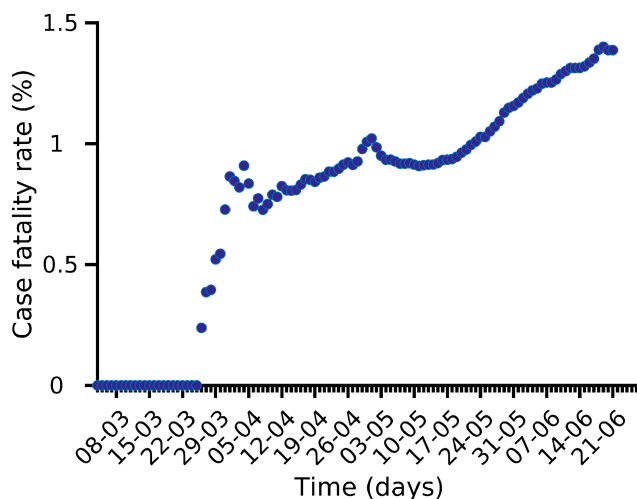
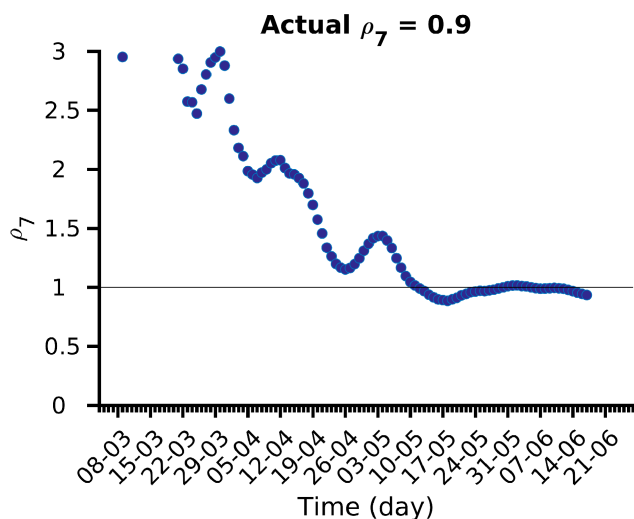
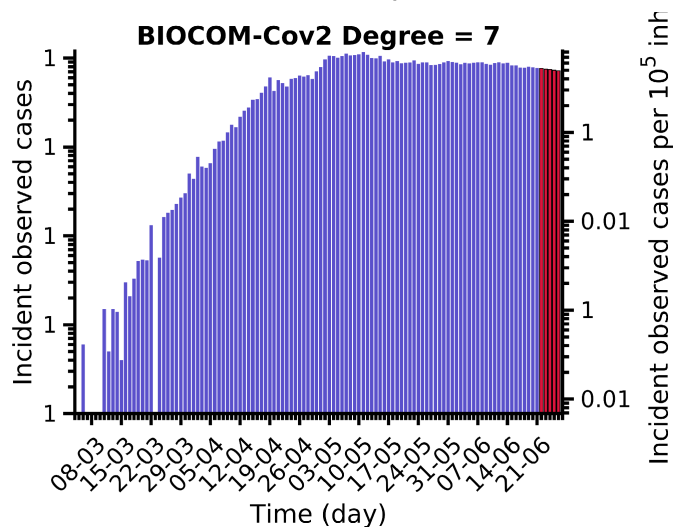
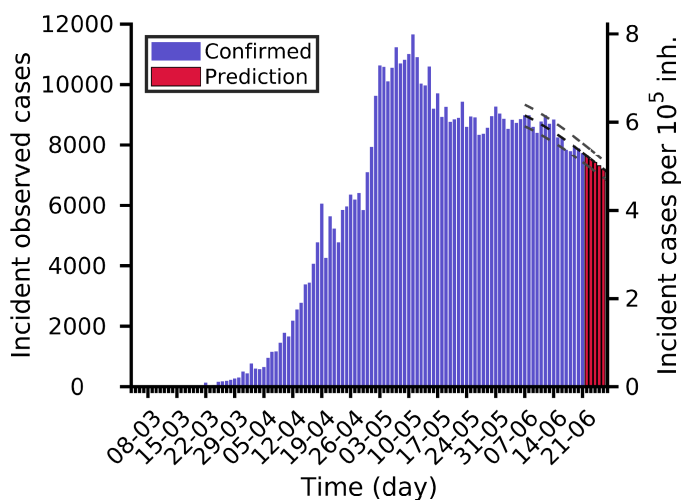
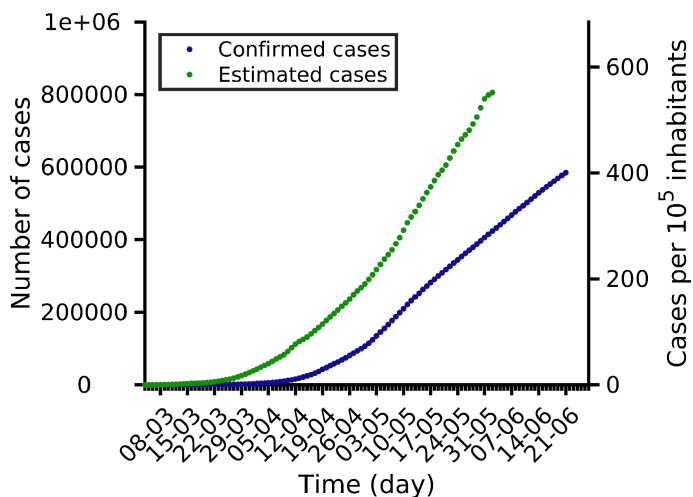
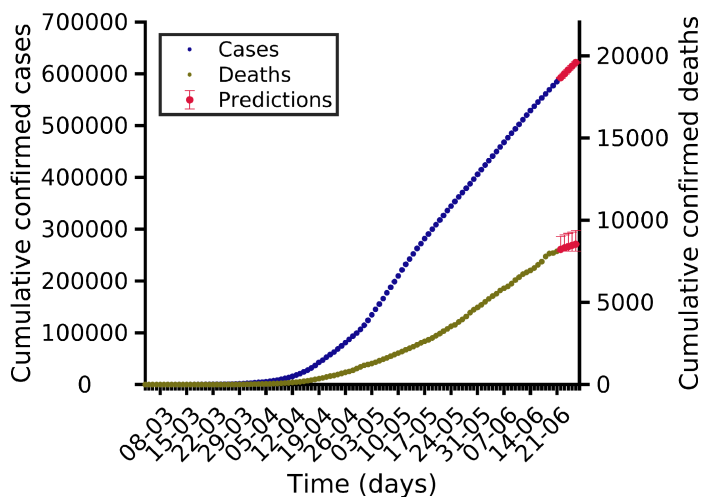
Data obtained from <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>

USA 21-06-2020. Population: 331.0M. Current cumulative incidence: 689/10⁵

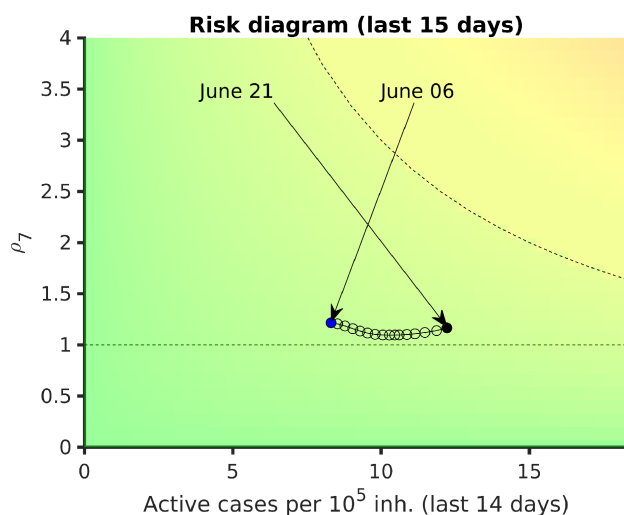
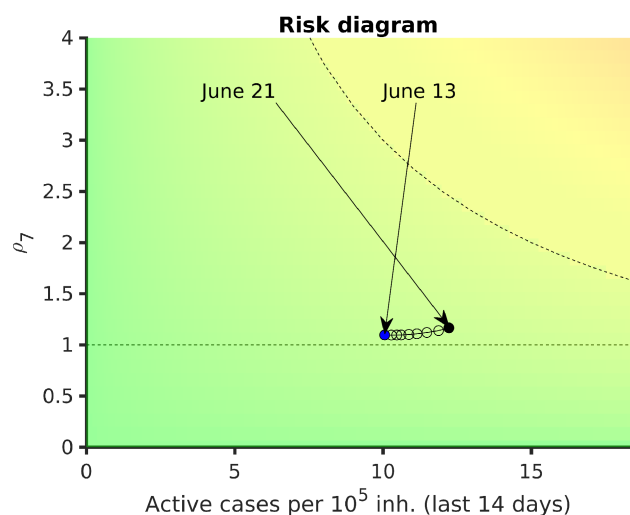
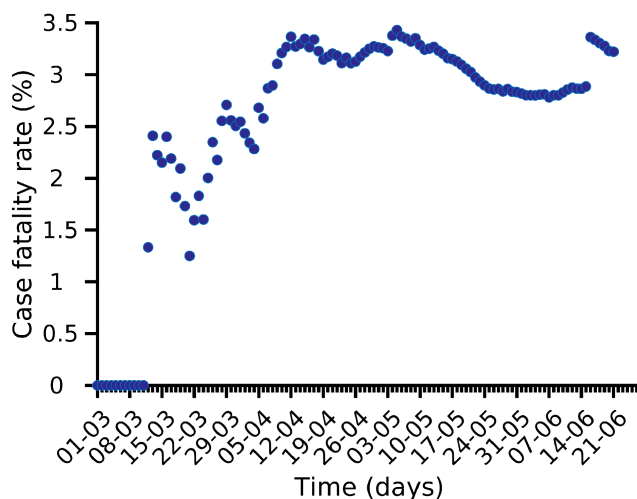
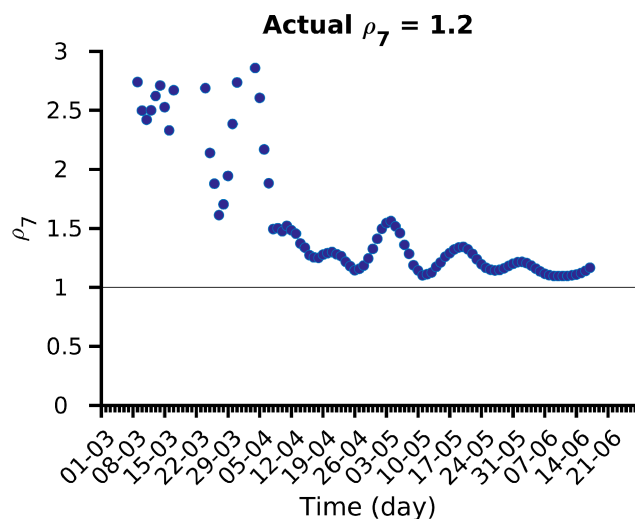
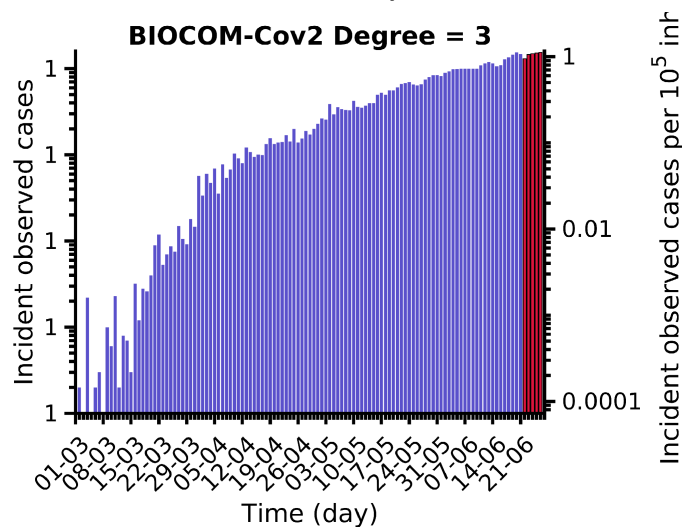
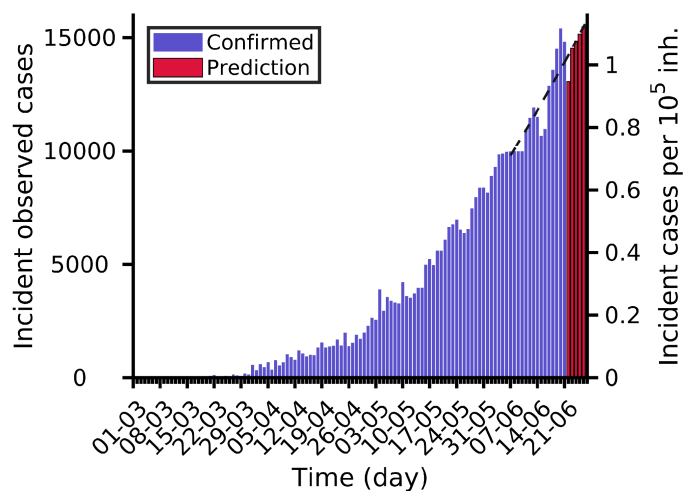
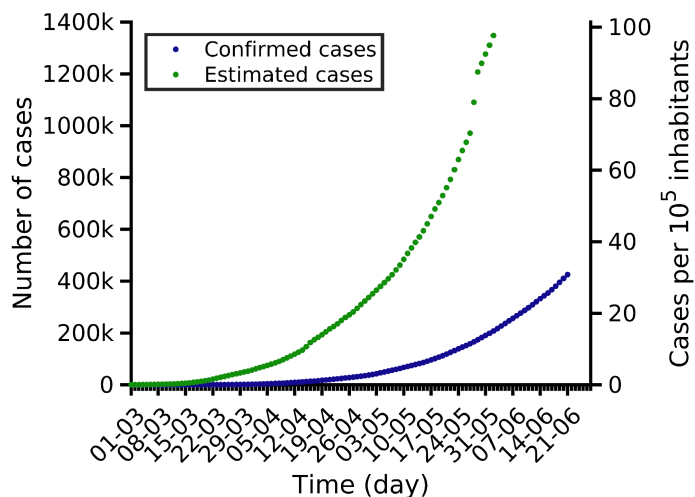
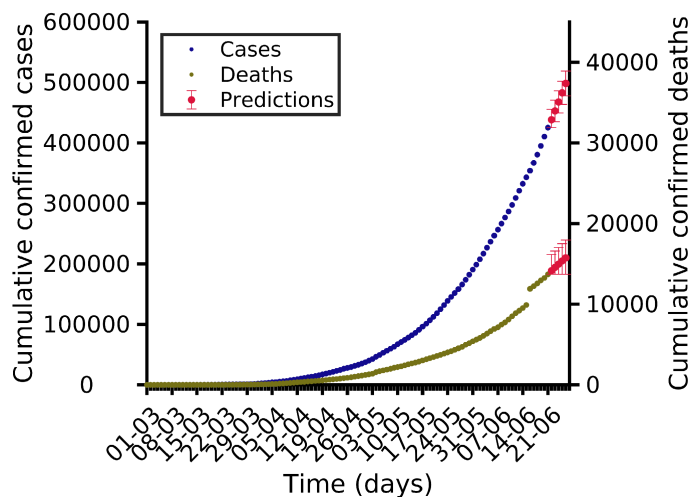


Brazil 21-06-2020. Population: 212.6M. Current cumulative incidence: 510/10⁵

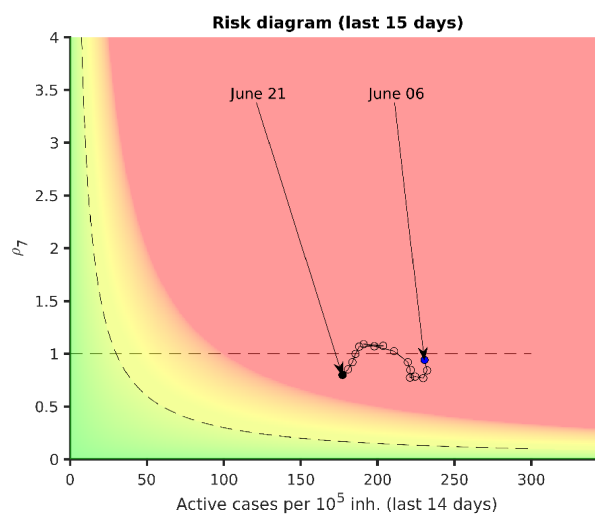
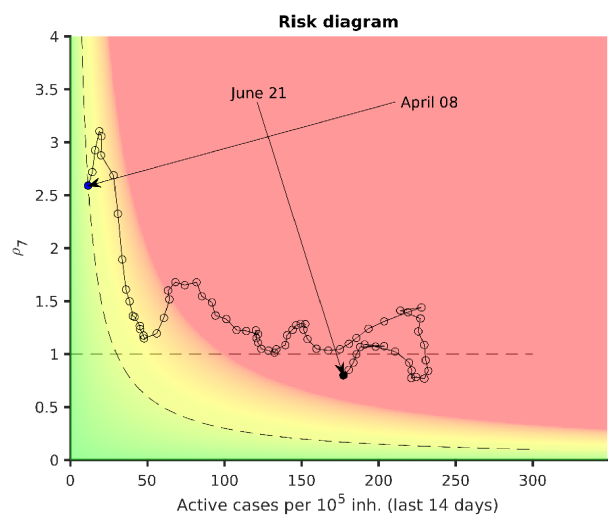
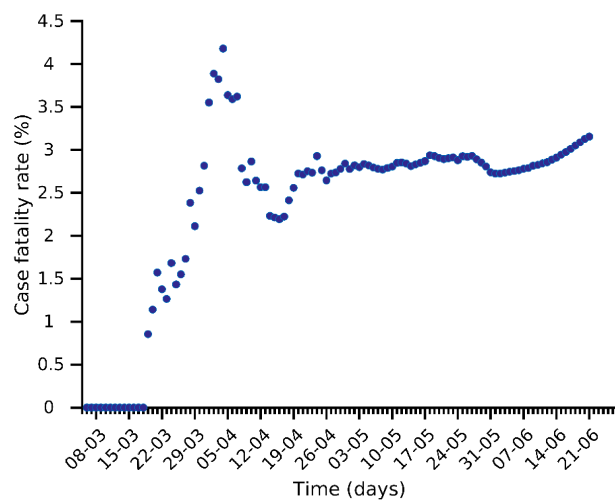
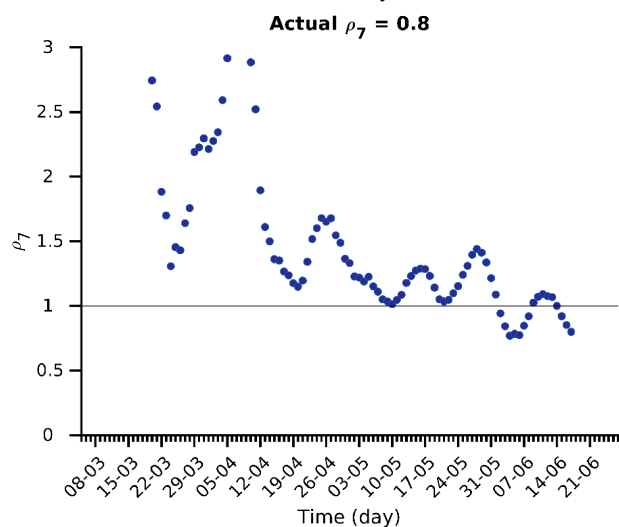
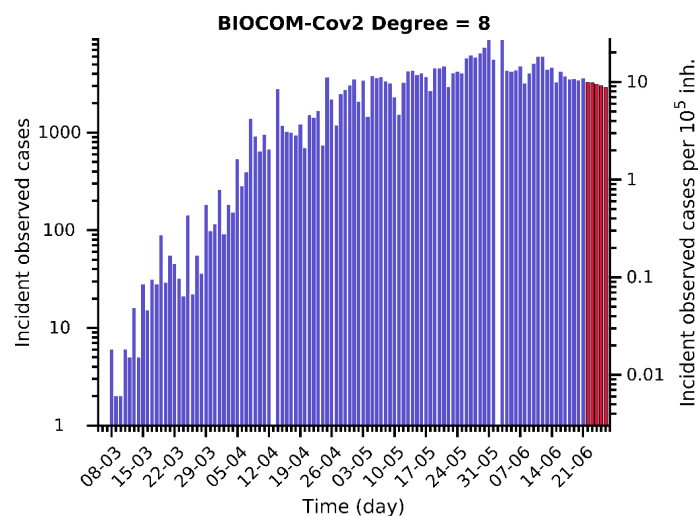
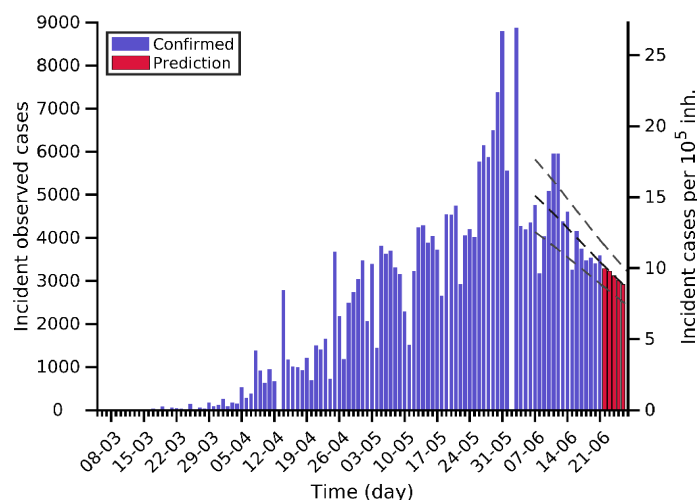
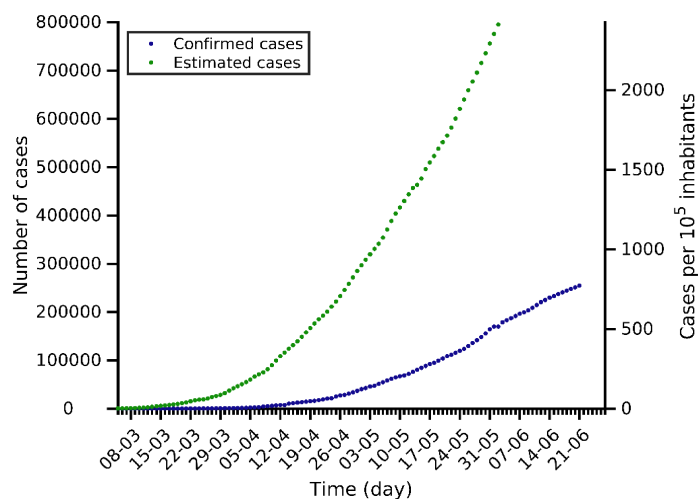
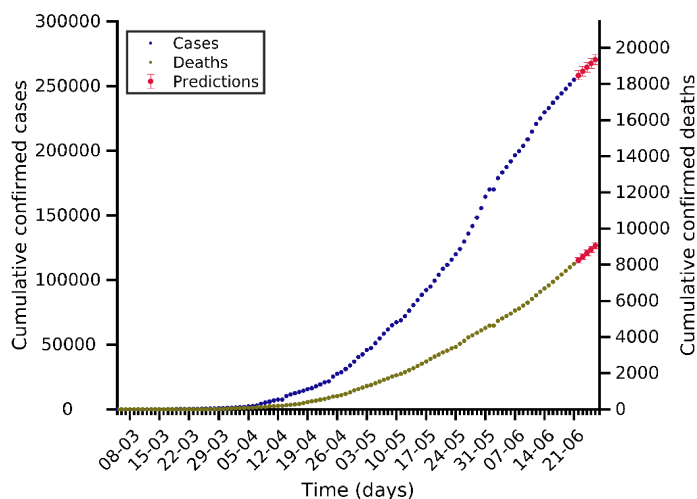




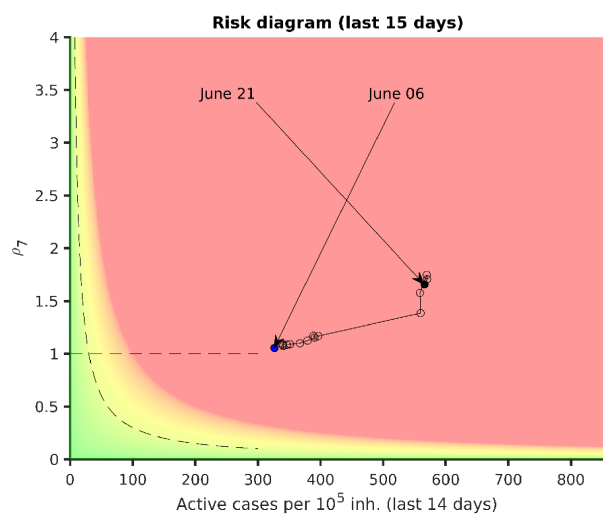
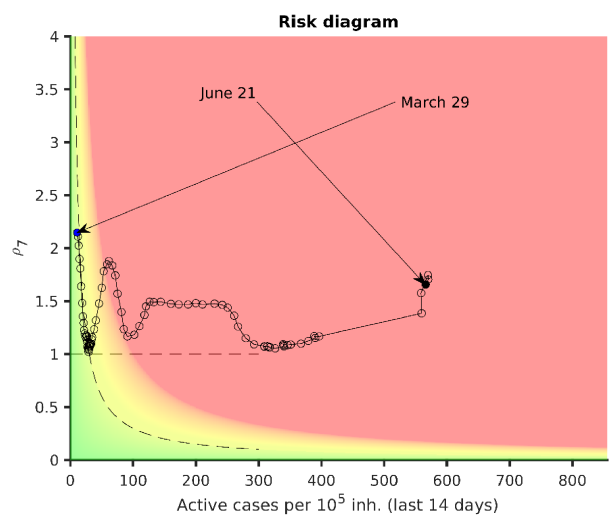
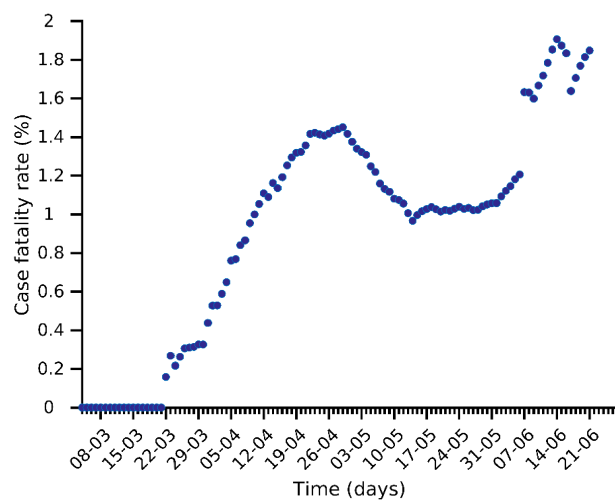
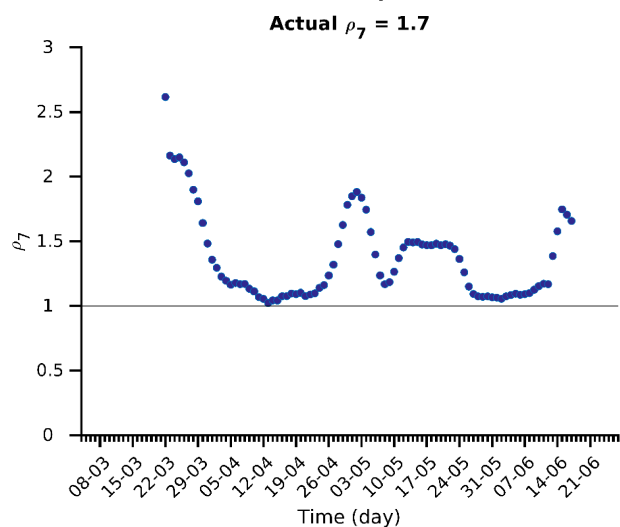
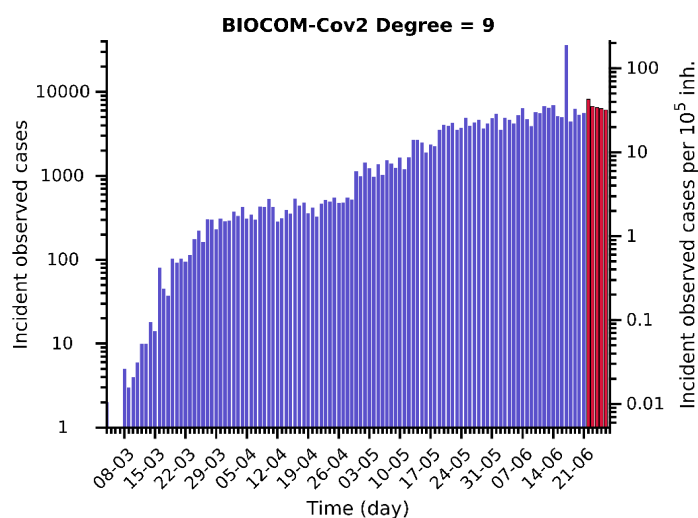
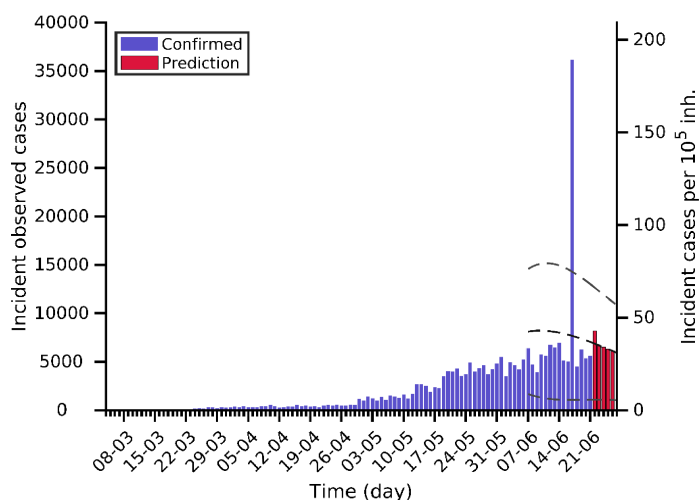
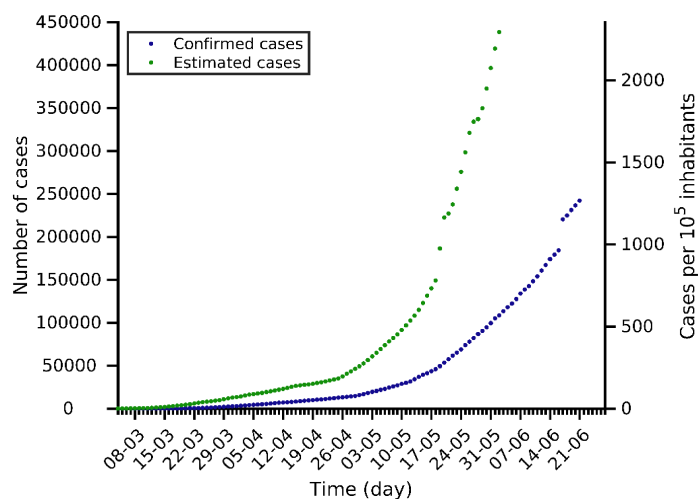
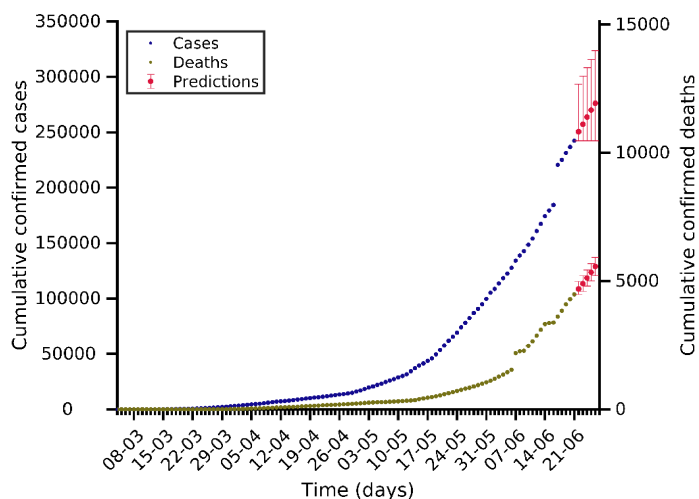
India 21-06-2020. Population: 1380.0M. Current cumulative incidence: 31/10⁵



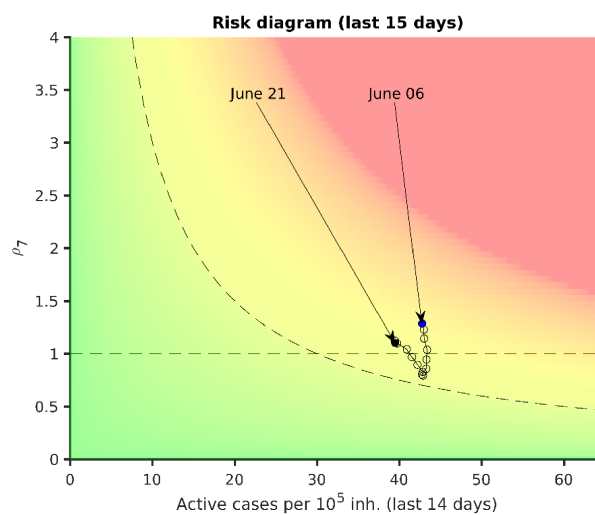
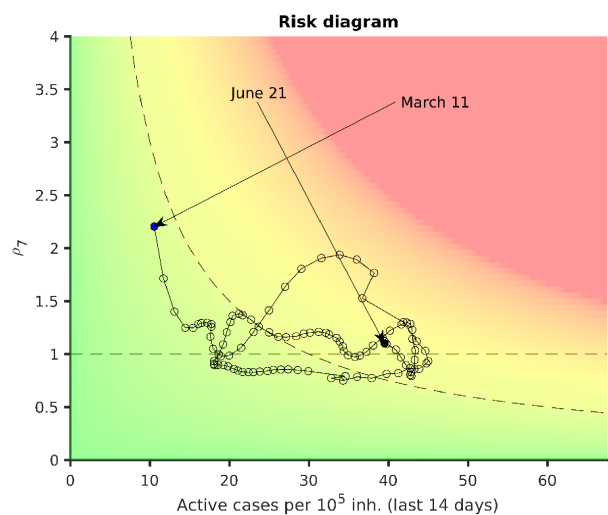
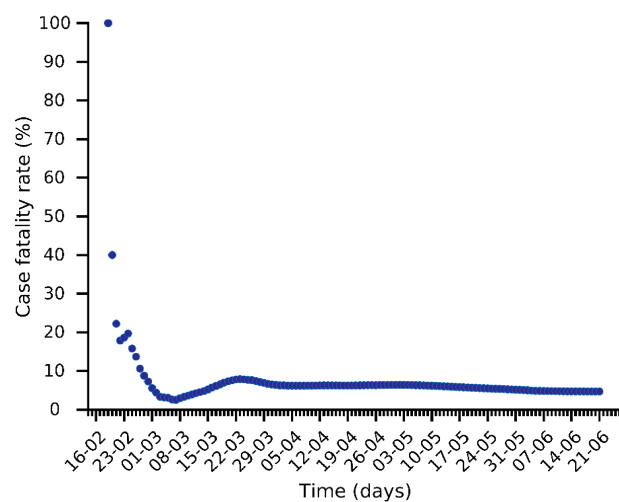
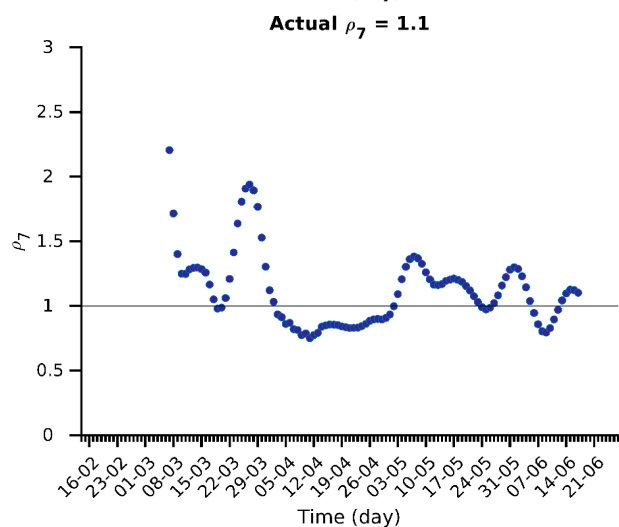
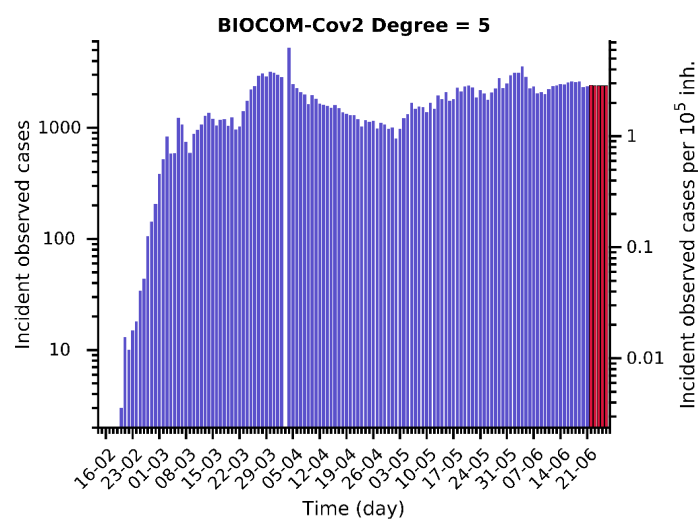
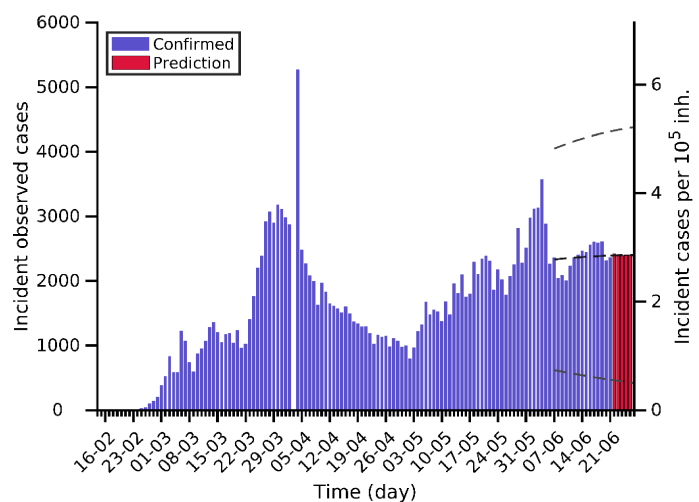
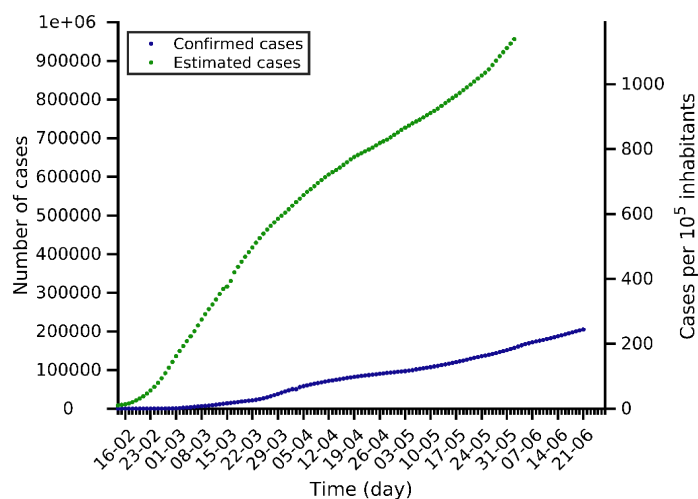
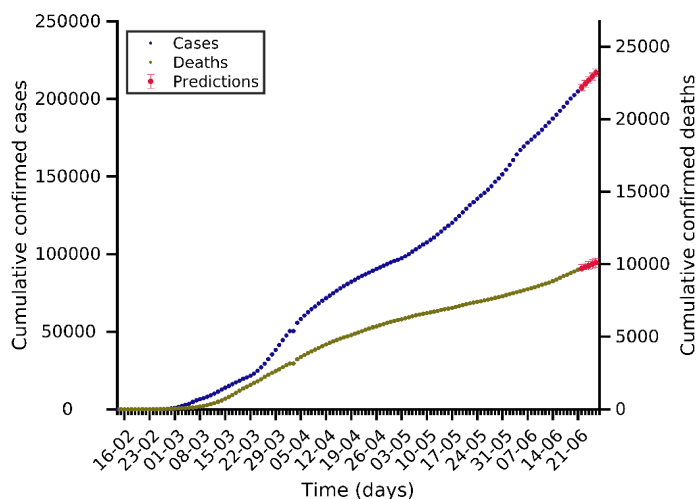
Peru 21-06-2020. Population: 33.0M. Current cumulative incidence: 773/10⁵



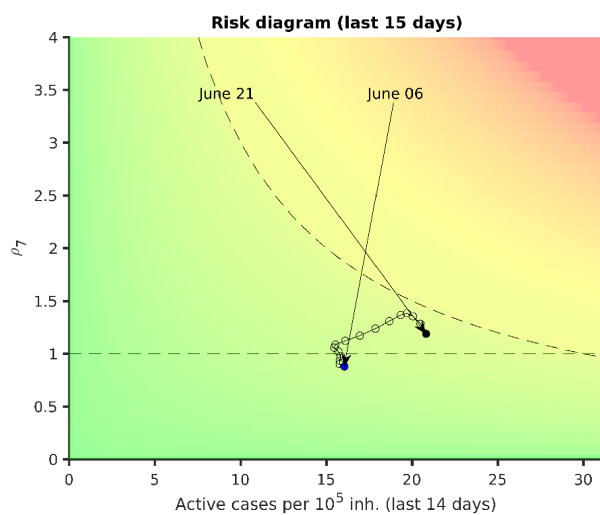
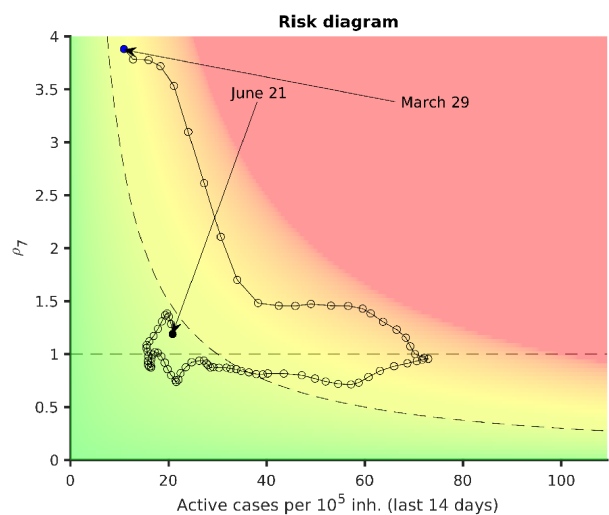
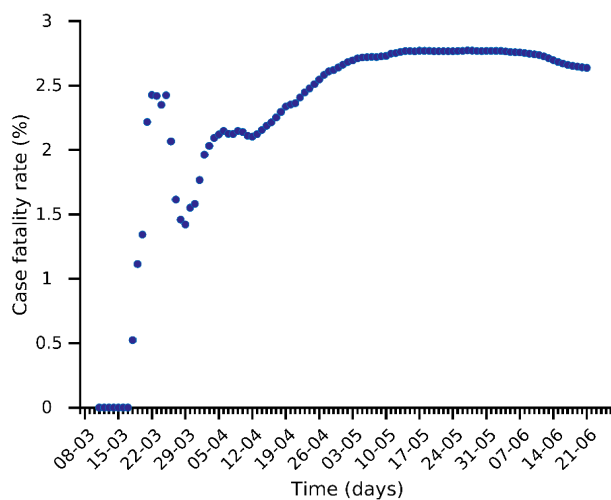
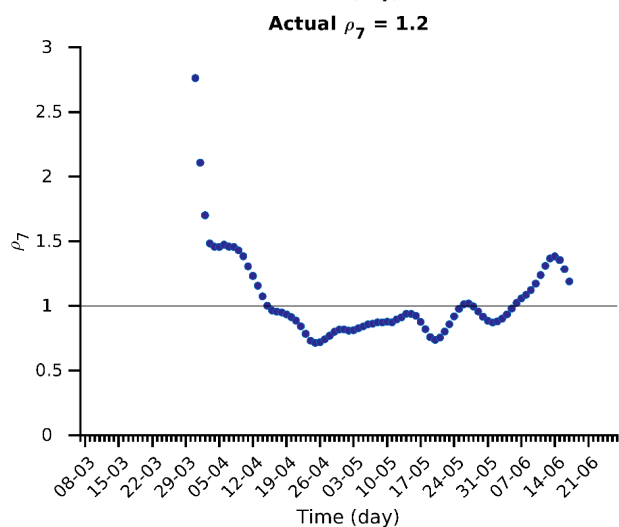
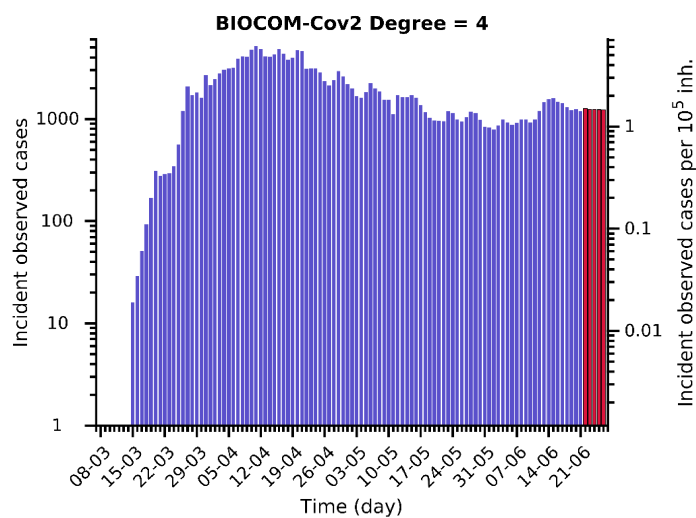
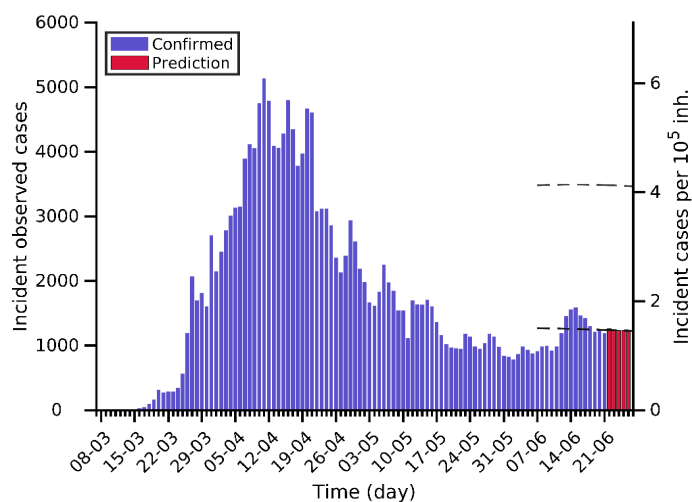
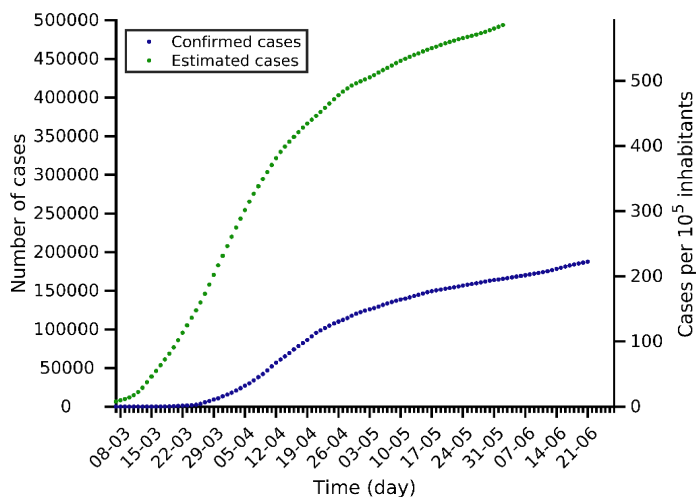
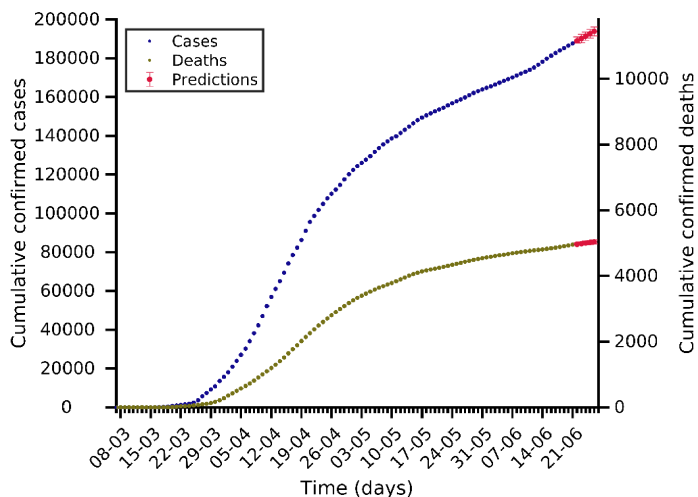
Chile 21-06-2020. Population: 19.1M. Current cumulative incidence: 1268/10⁵



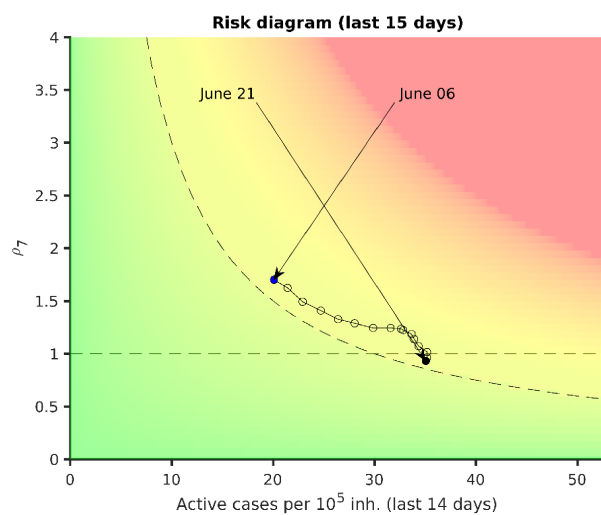
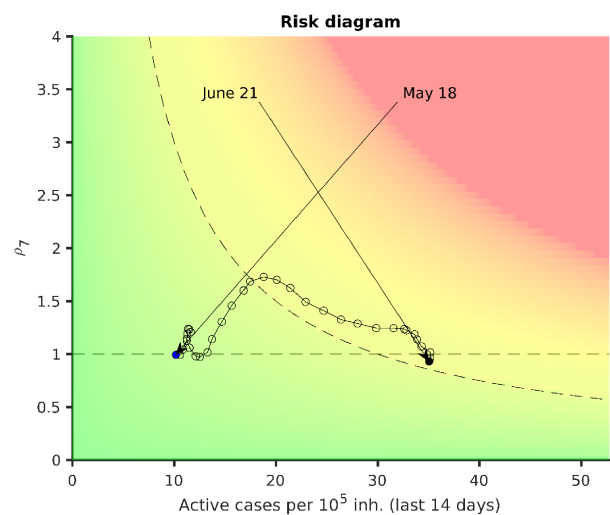
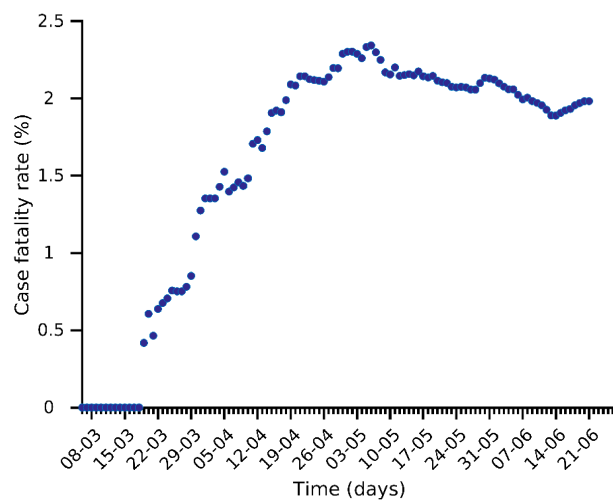
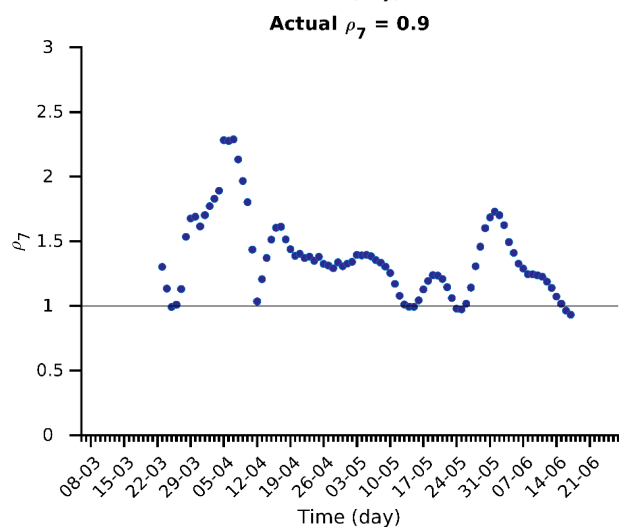
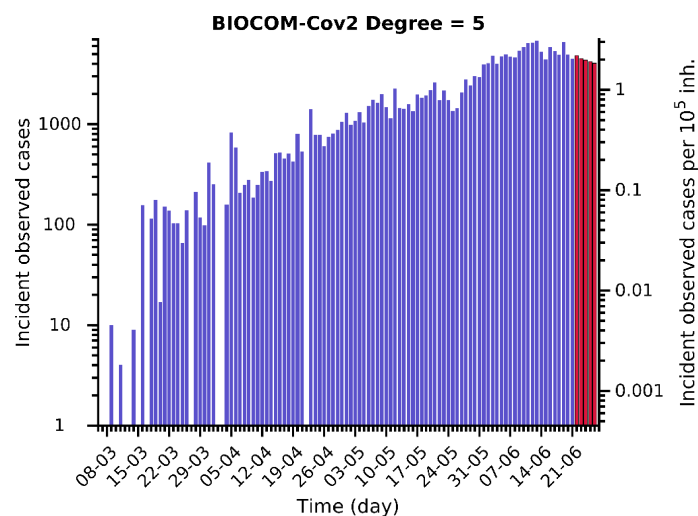
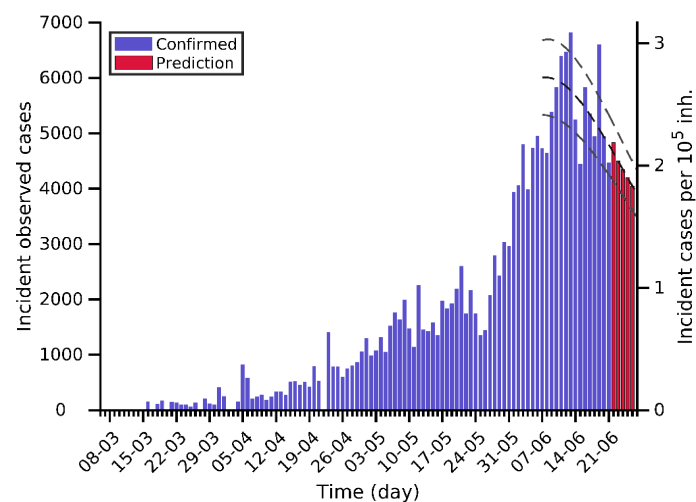
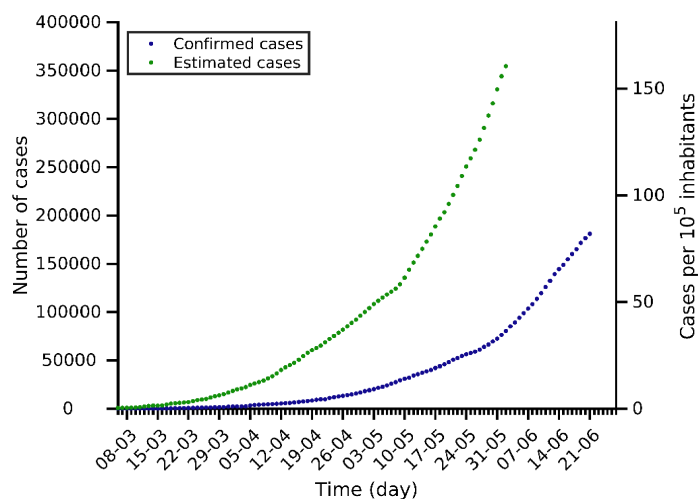
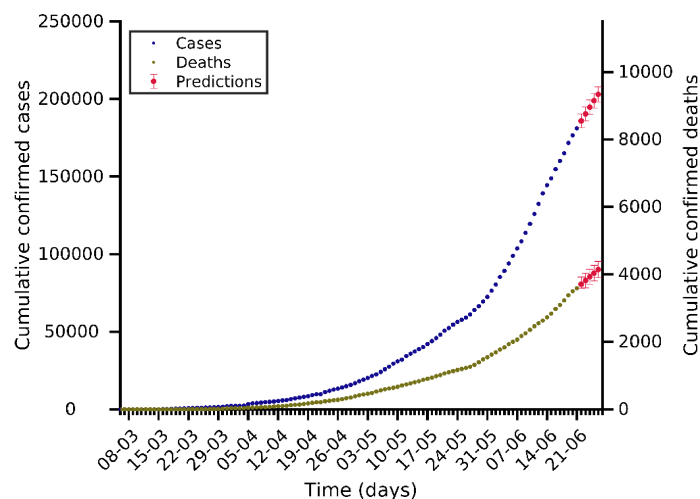
Iran 21-06-2020. Population: 84.0M. Current cumulative incidence: 244/10⁵



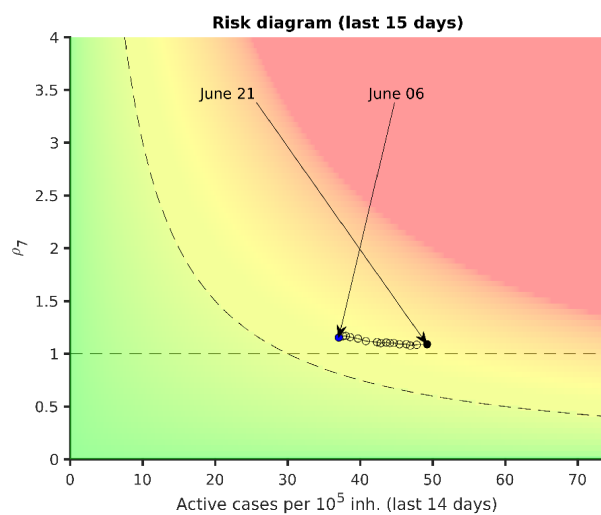
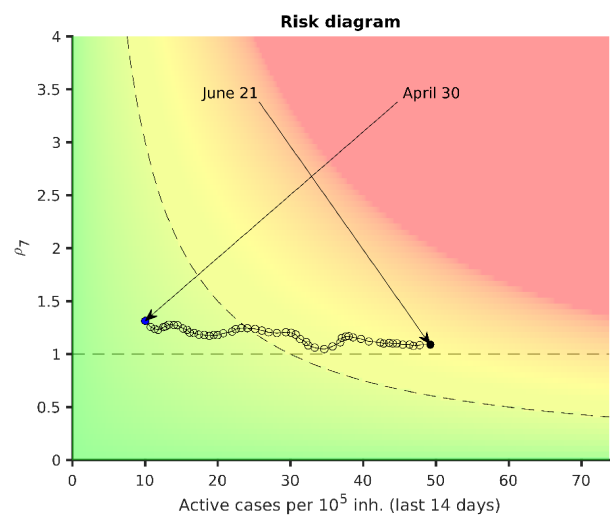
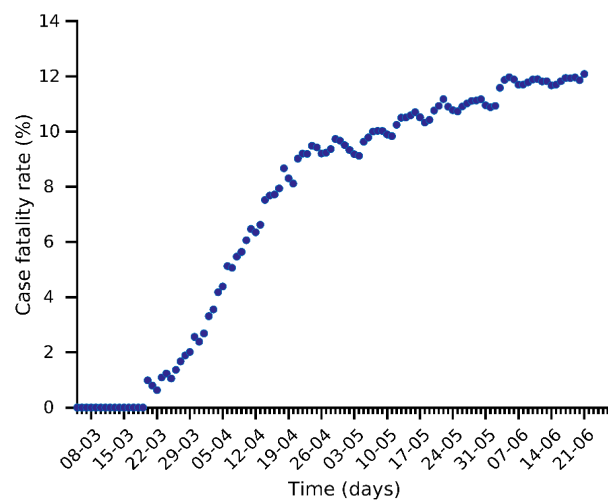
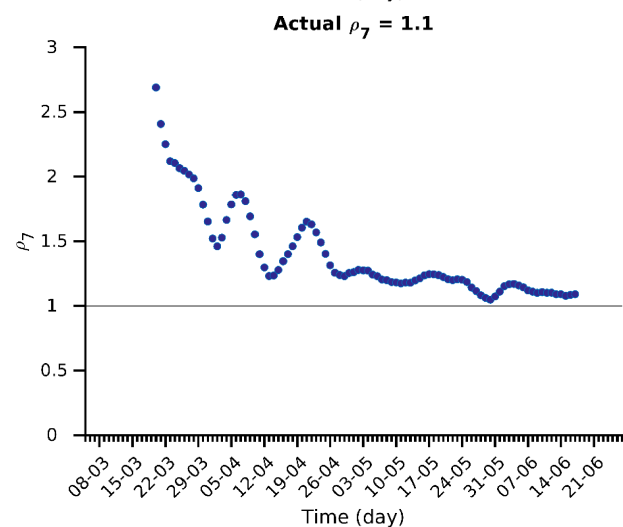
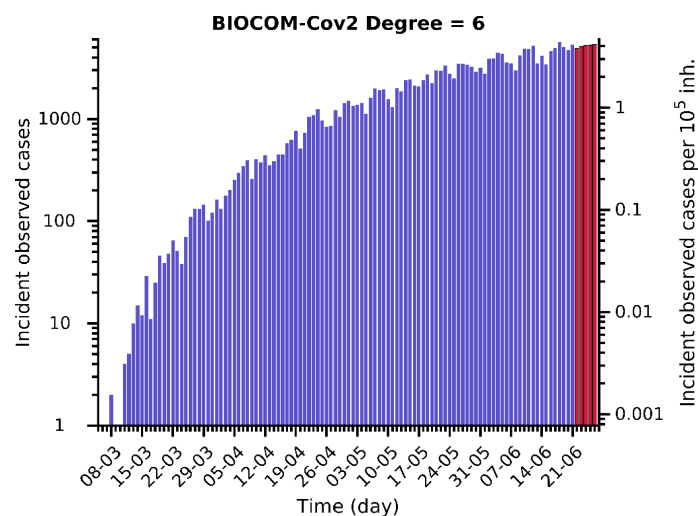
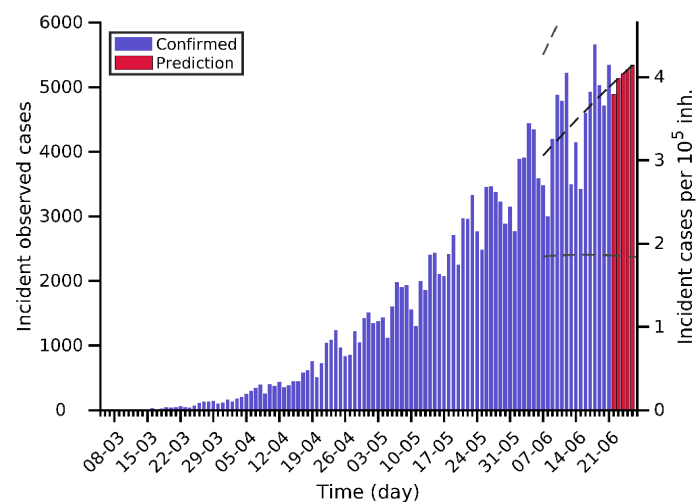
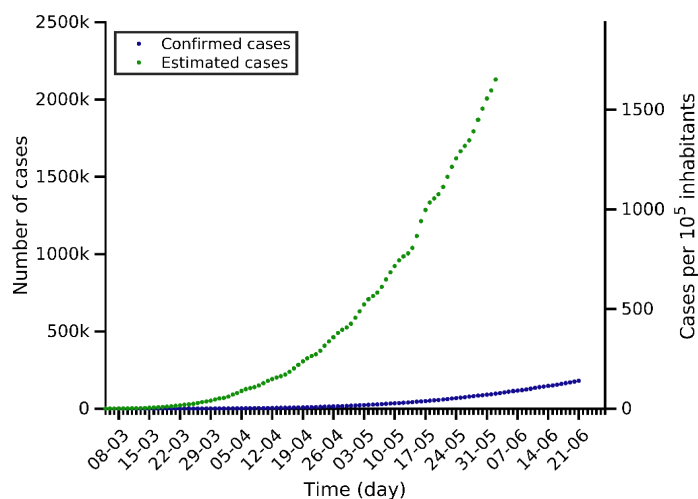
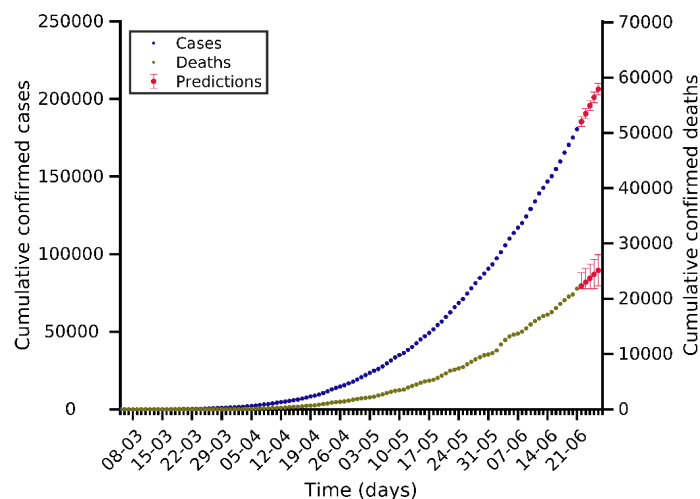
Turkey 21-06-2020. Population: 84.3M. Current cumulative incidence: 223/10⁵

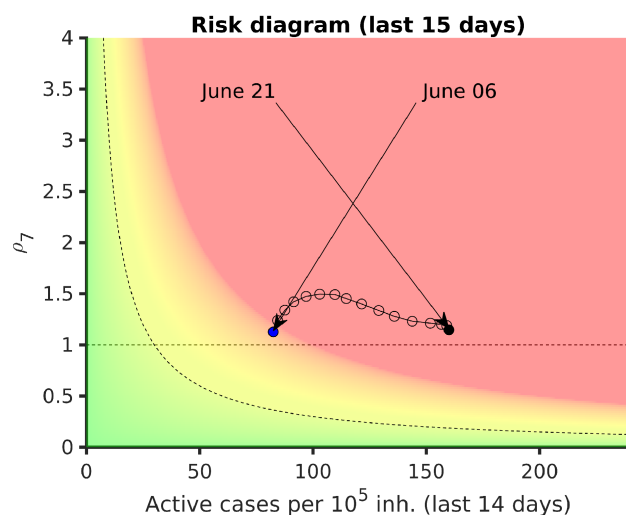
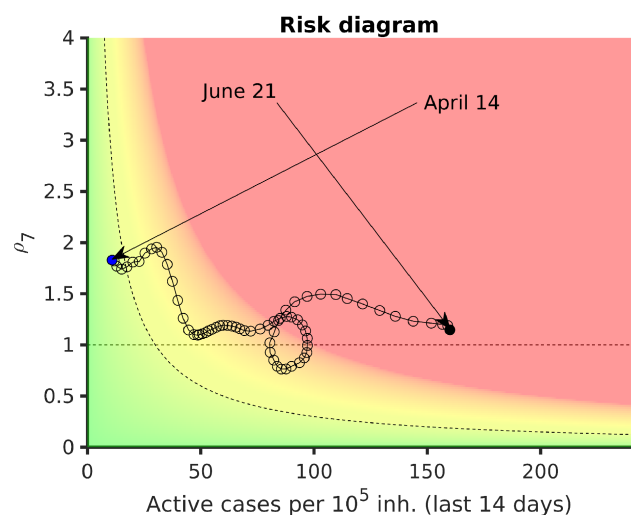
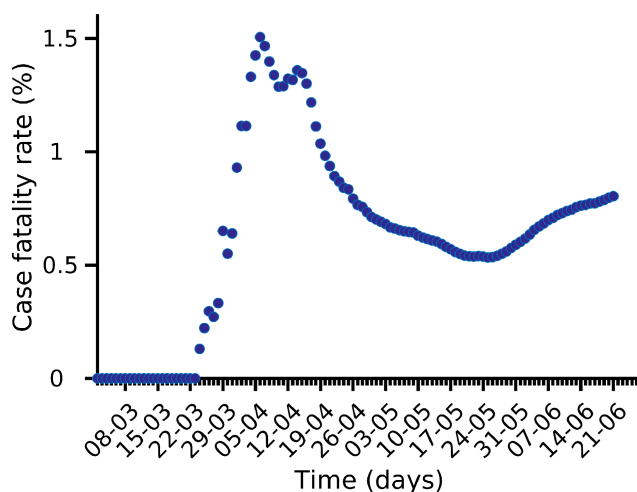
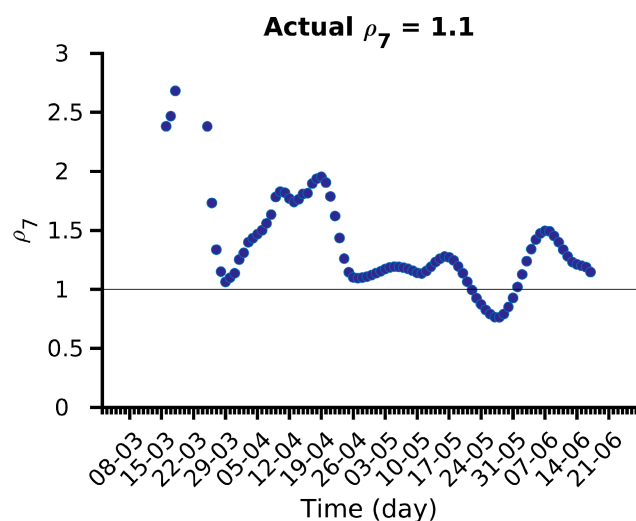
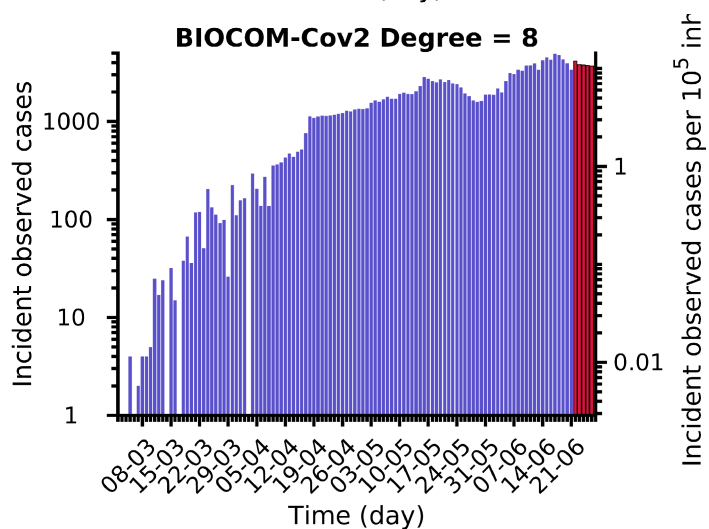
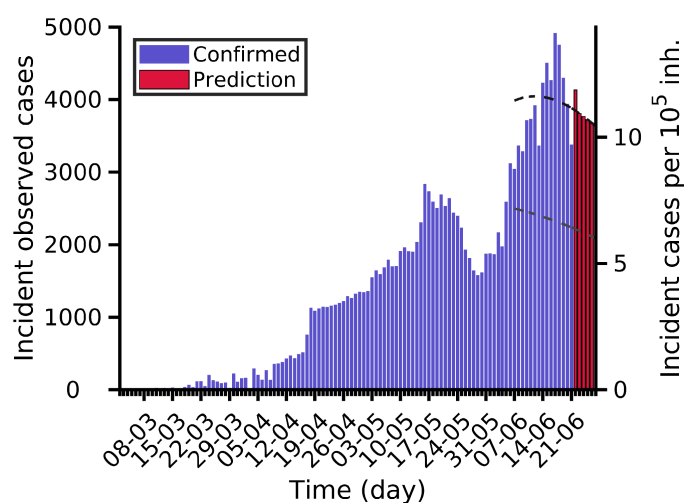
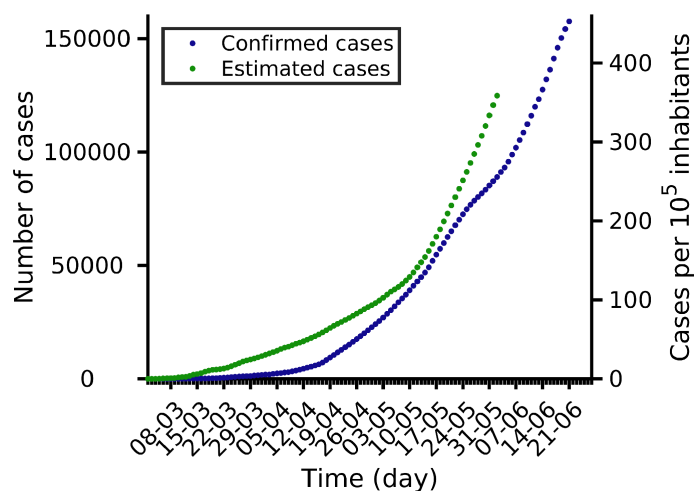
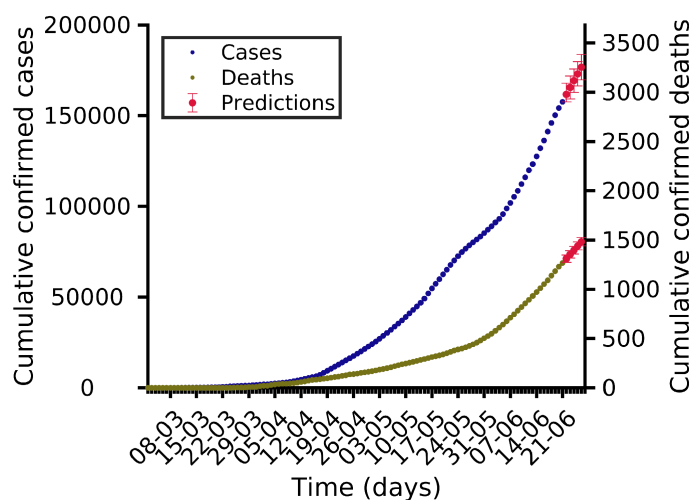


Pakistan 21-06-2020. Population: 220.9M. Current cumulative incidence: 82/10⁵

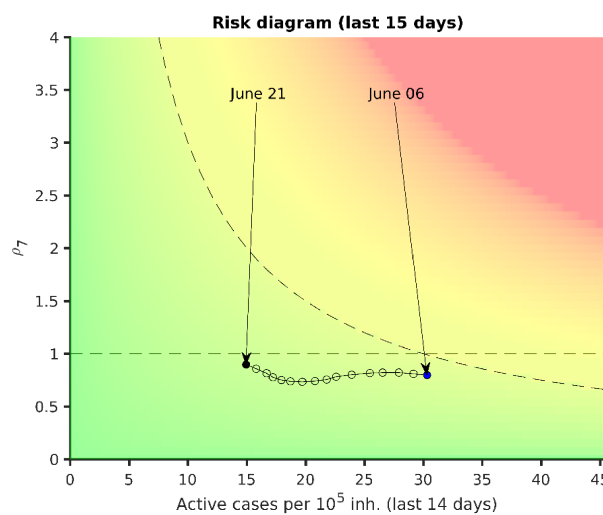
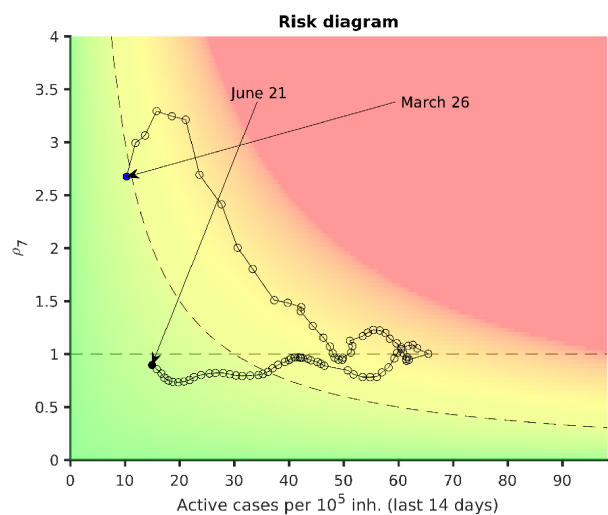
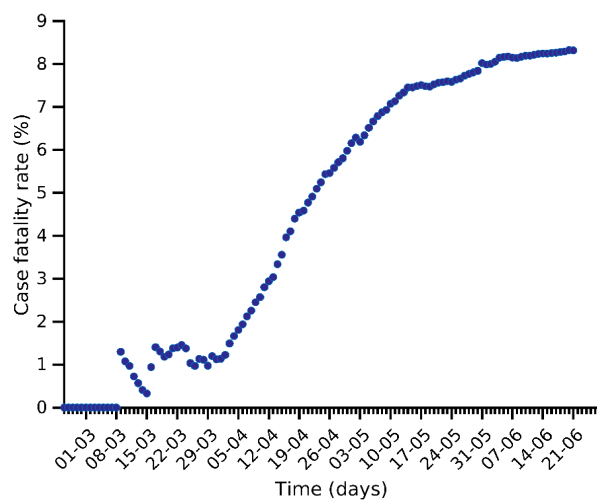
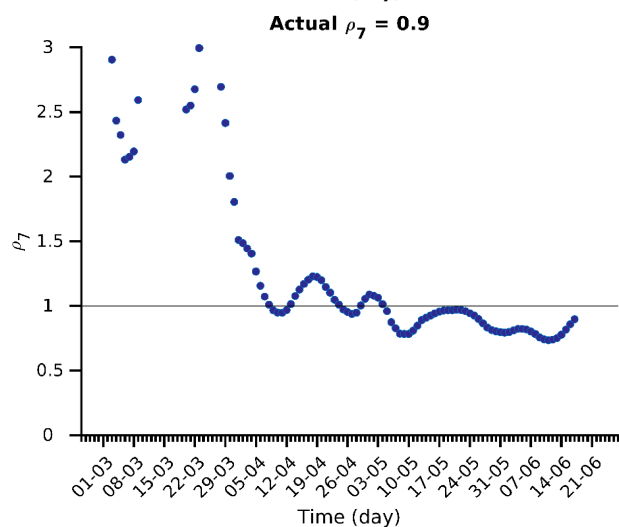
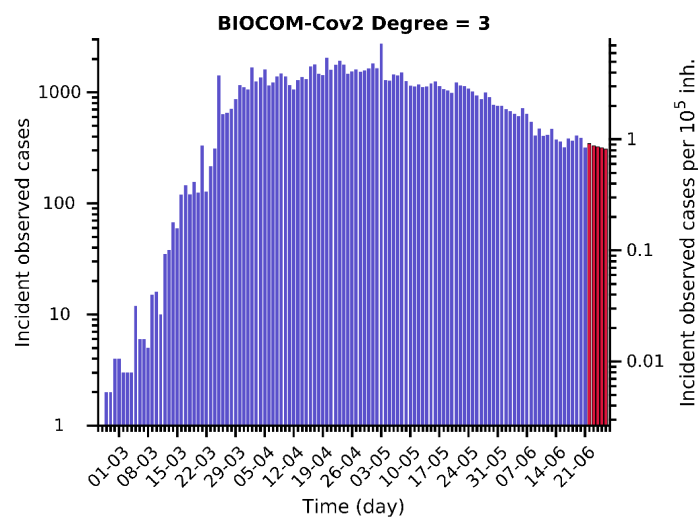
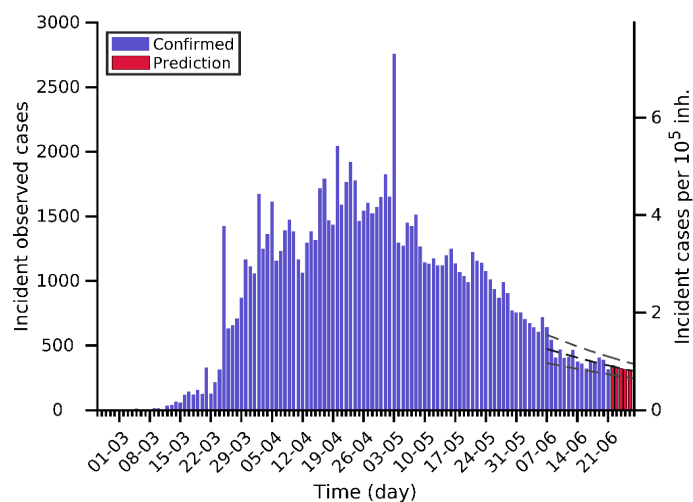
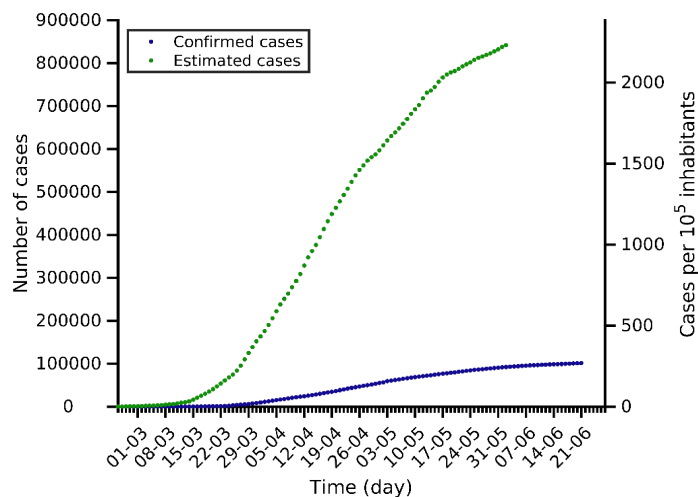
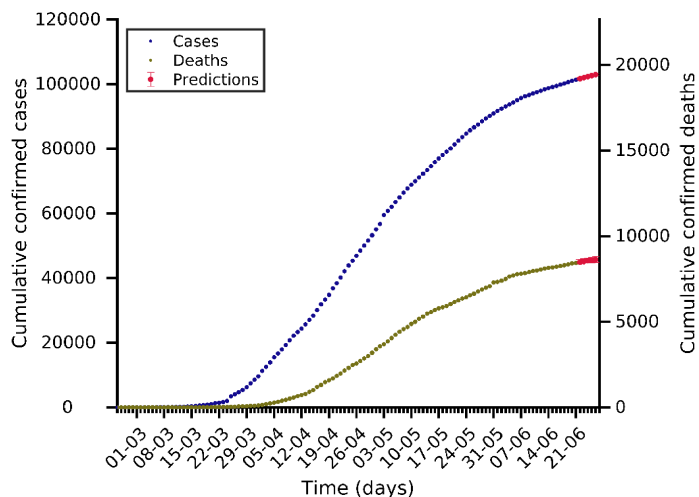


Mexico 21-06-2020. Population: 128.9M. Current cumulative incidence: 140/10⁵

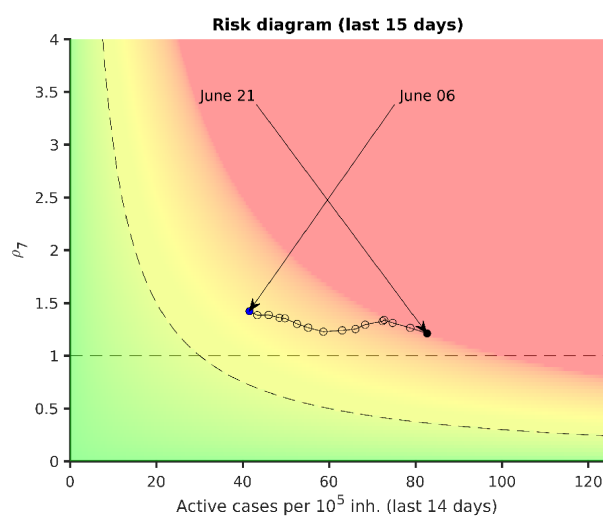
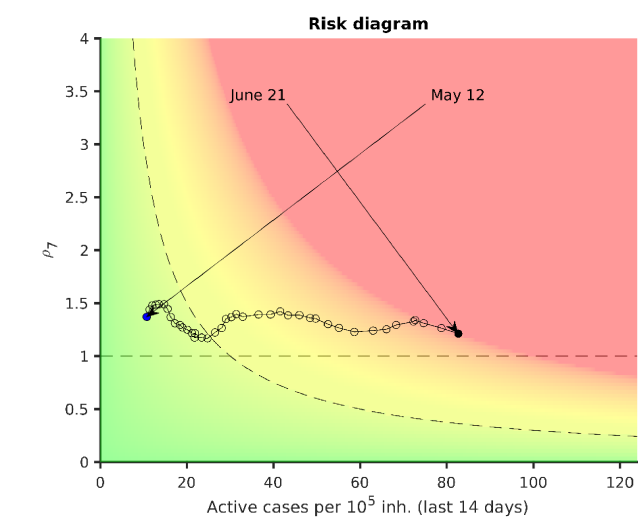
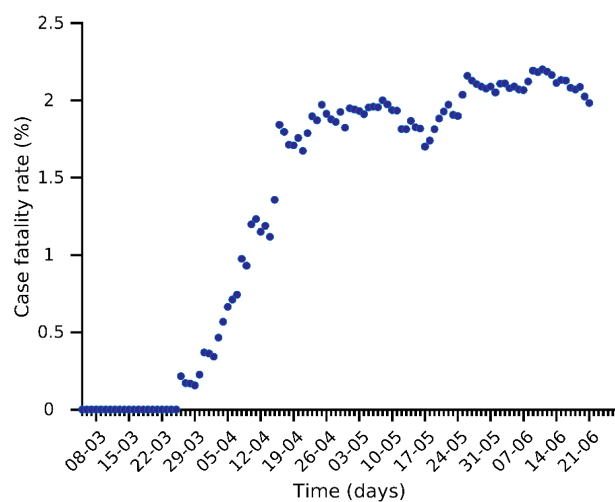
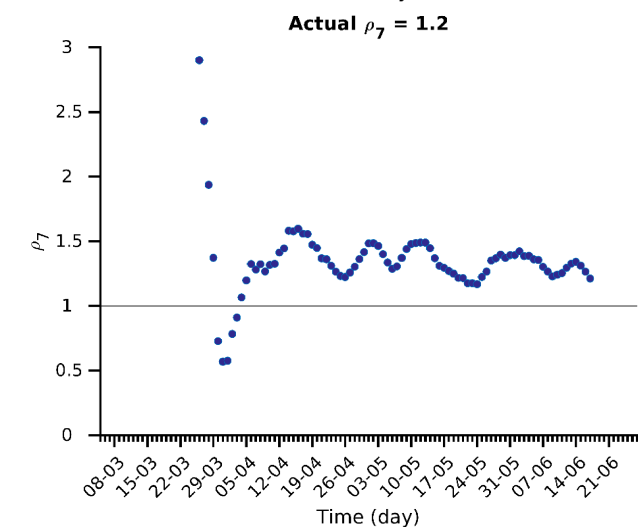
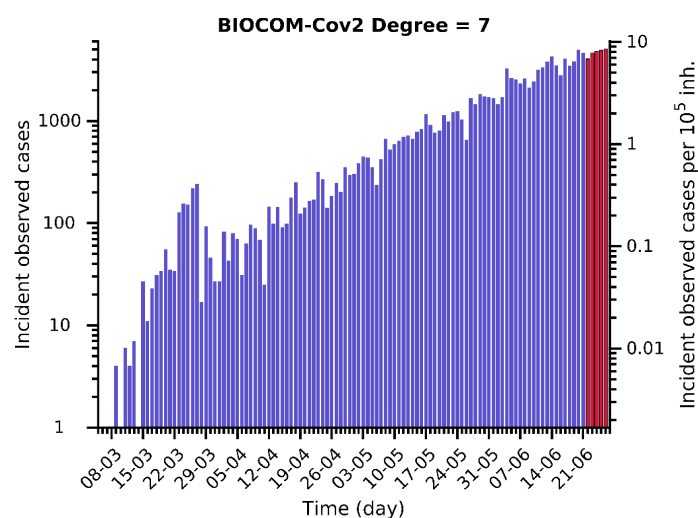
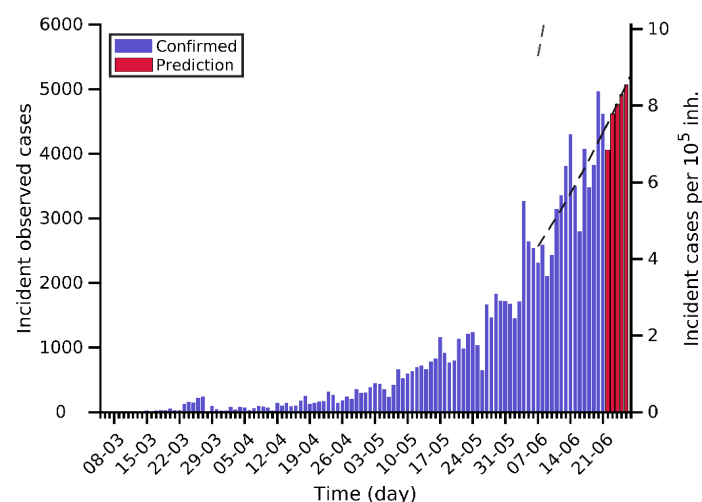
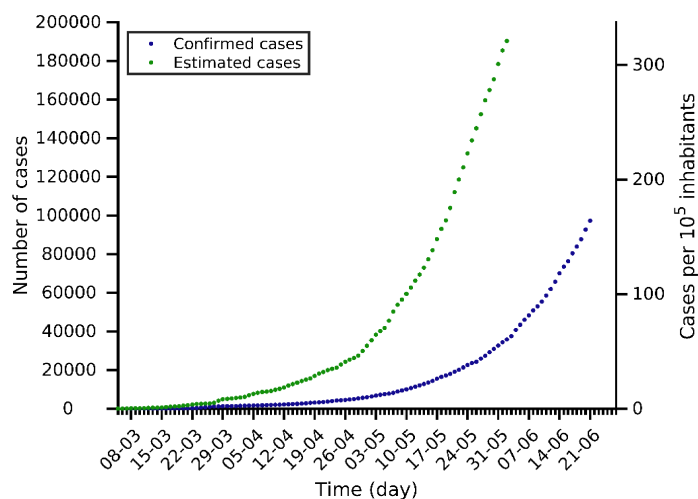
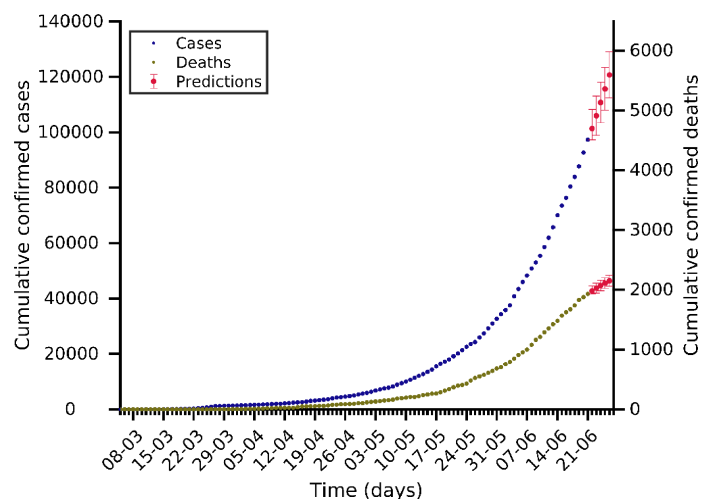


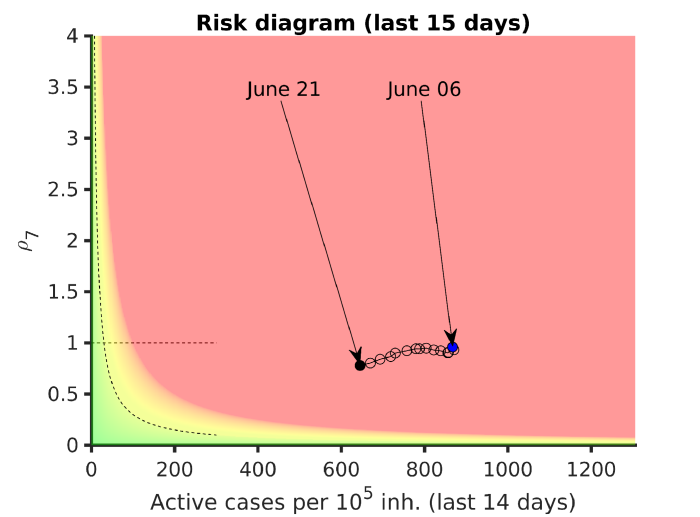
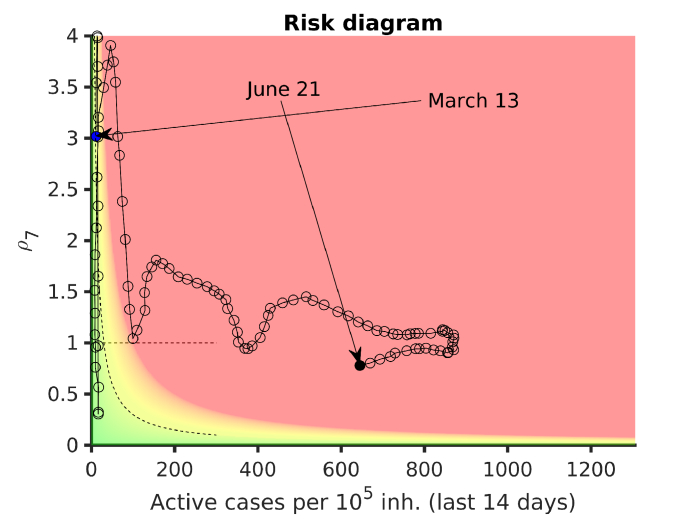
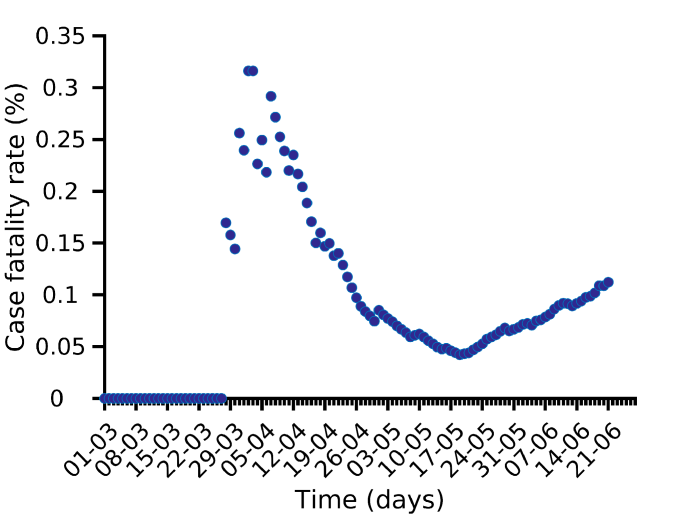
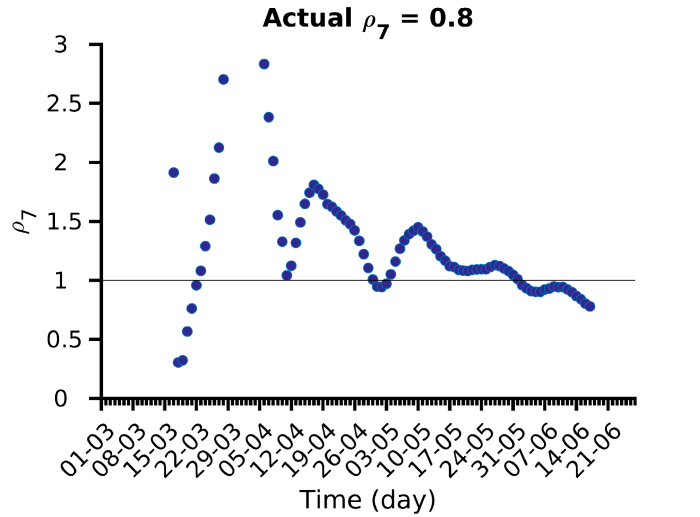
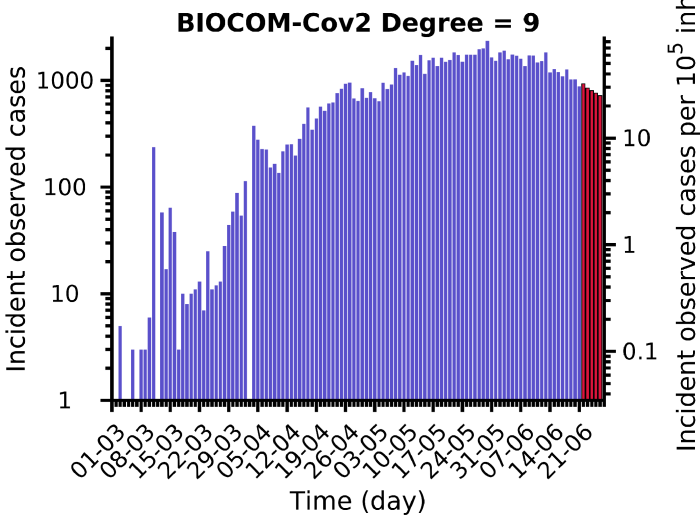
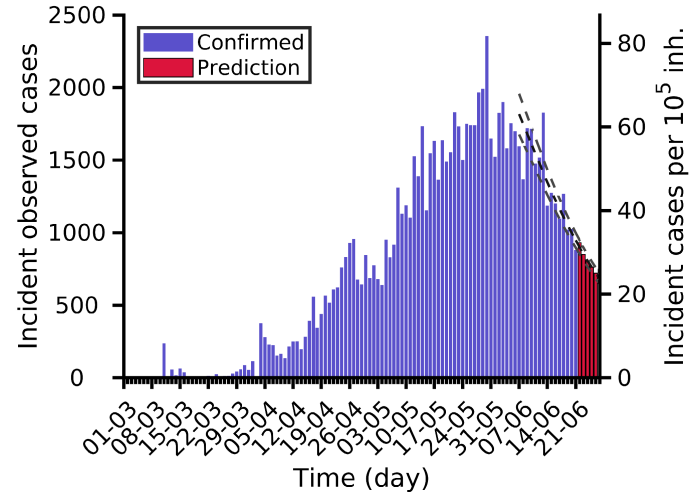
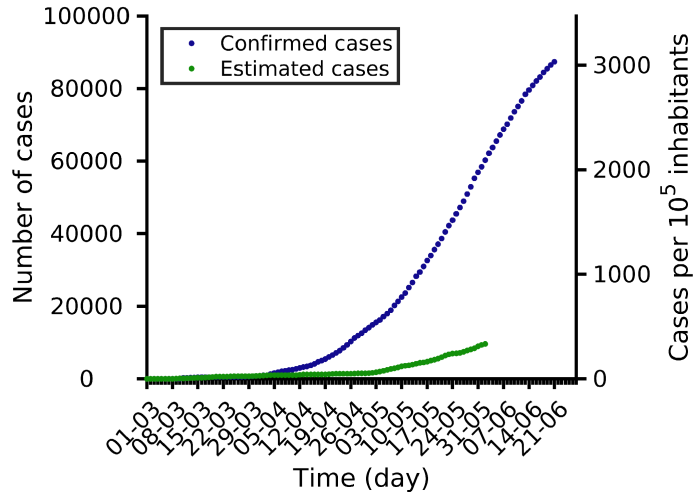
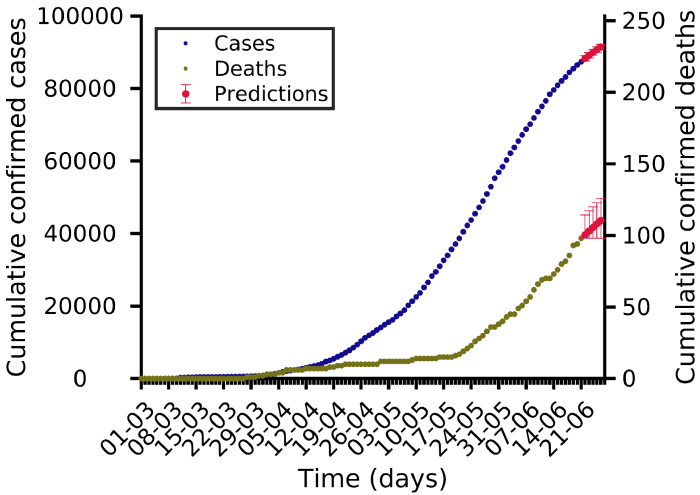


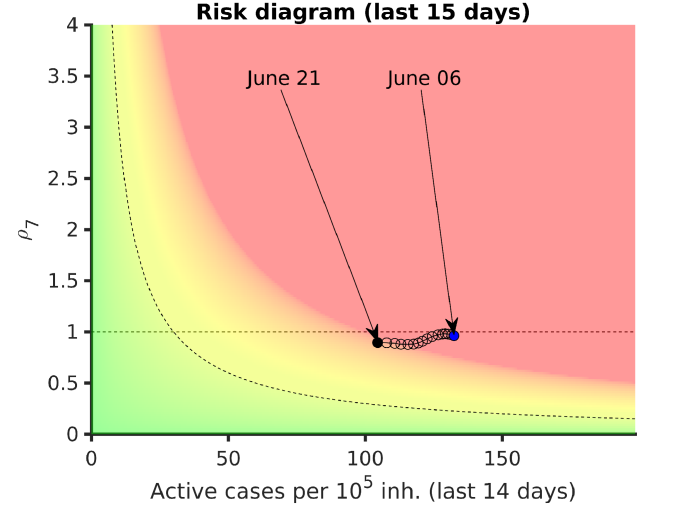
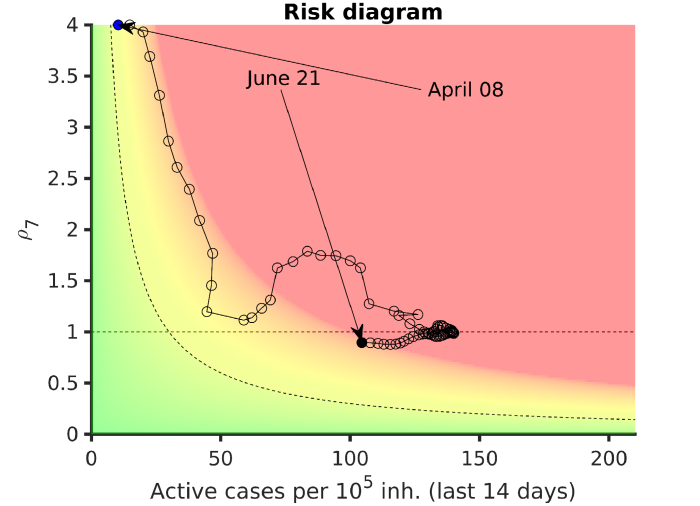
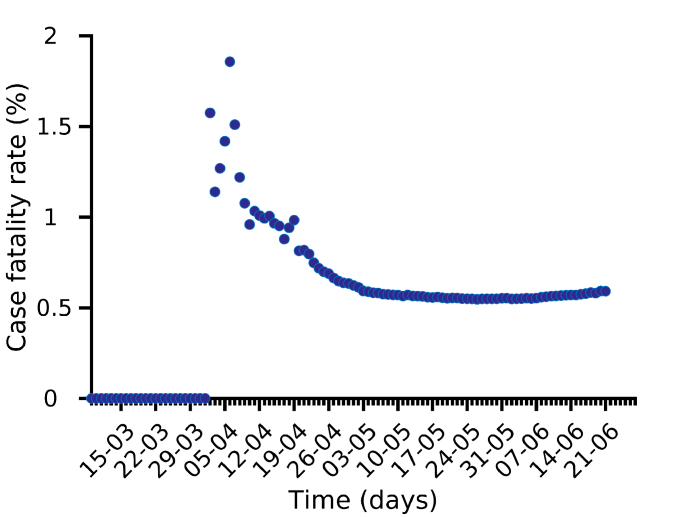
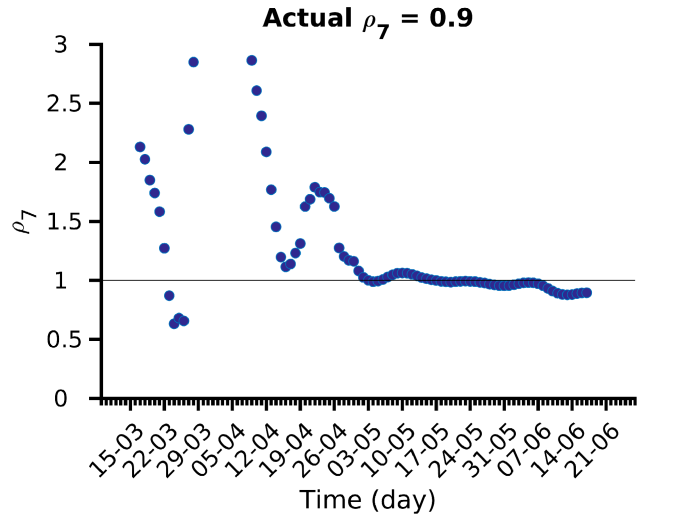
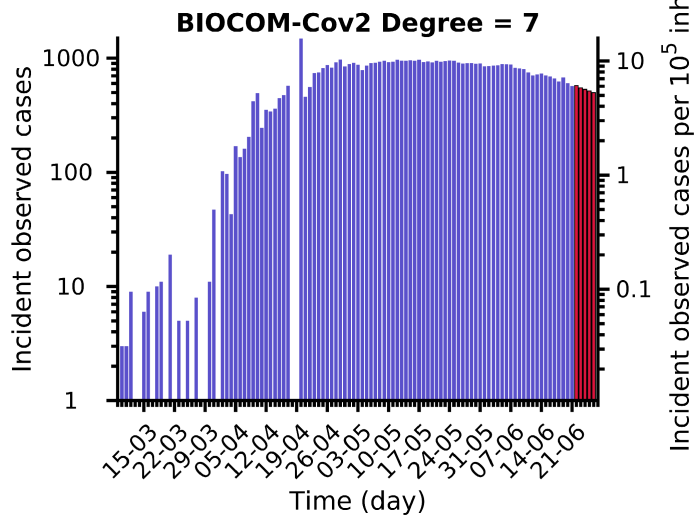
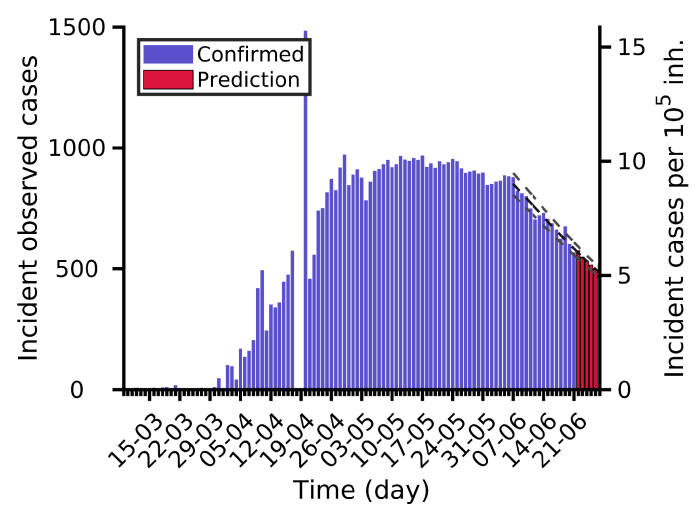
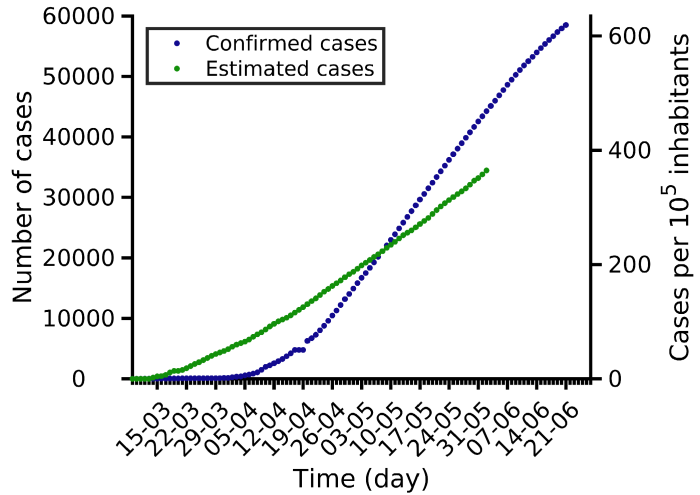
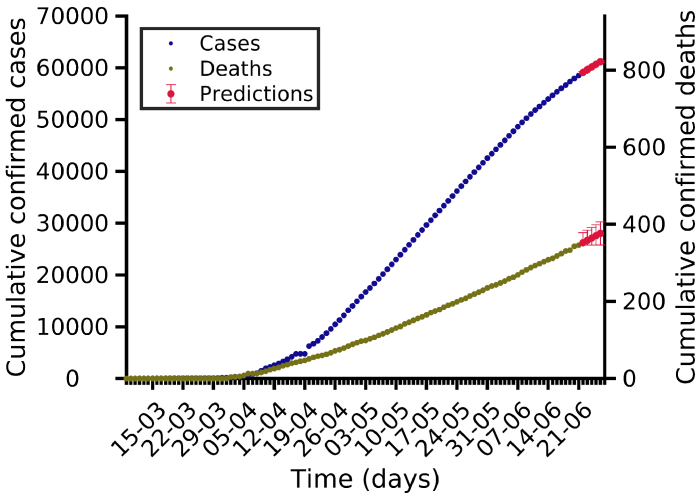
Canada 21-06-2020. Population: 37.7M. Current cumulative incidence: 268/10⁵



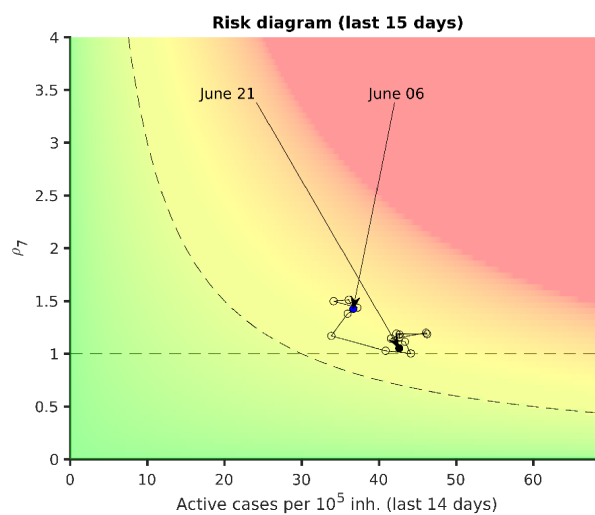
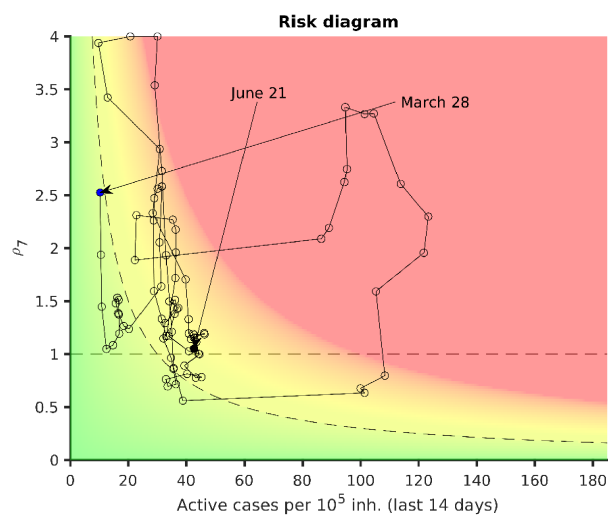
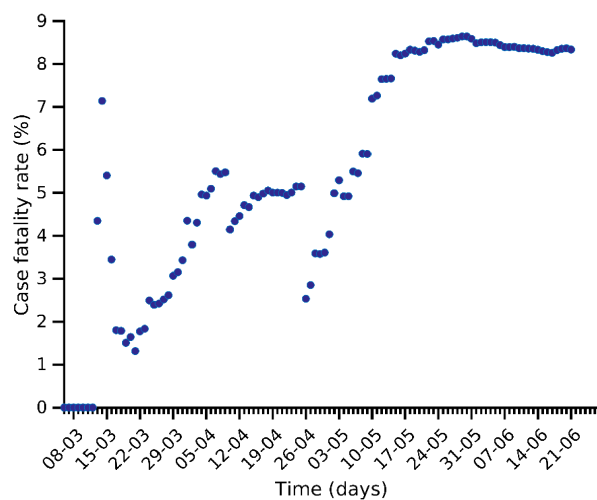
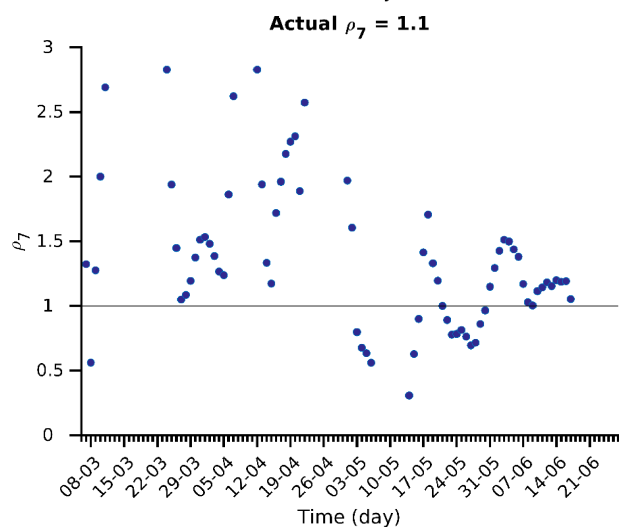
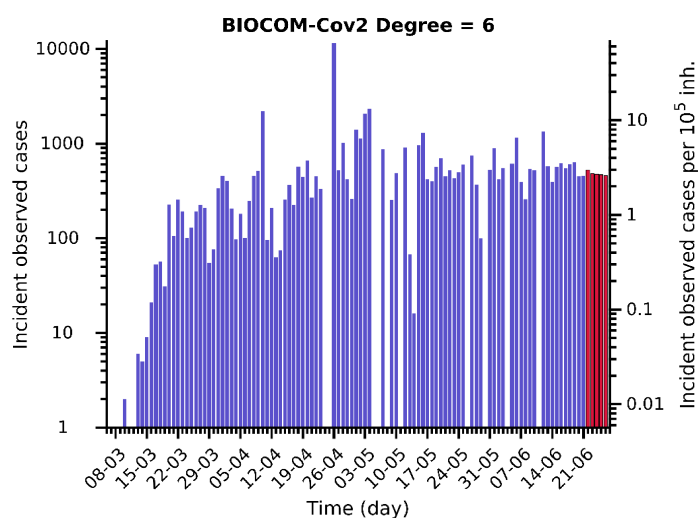
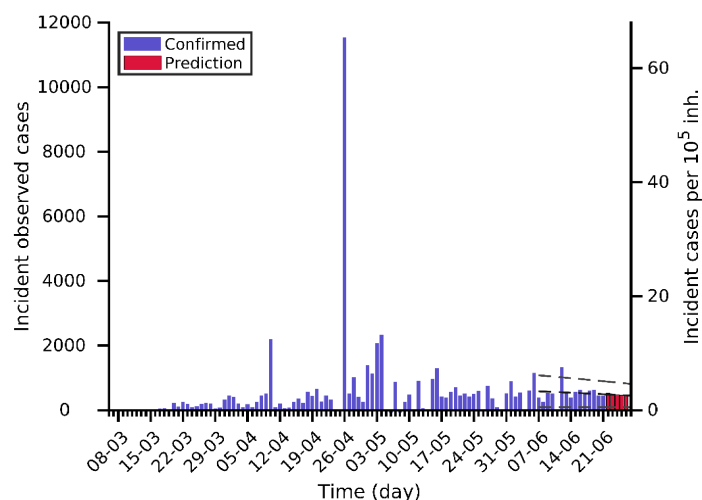
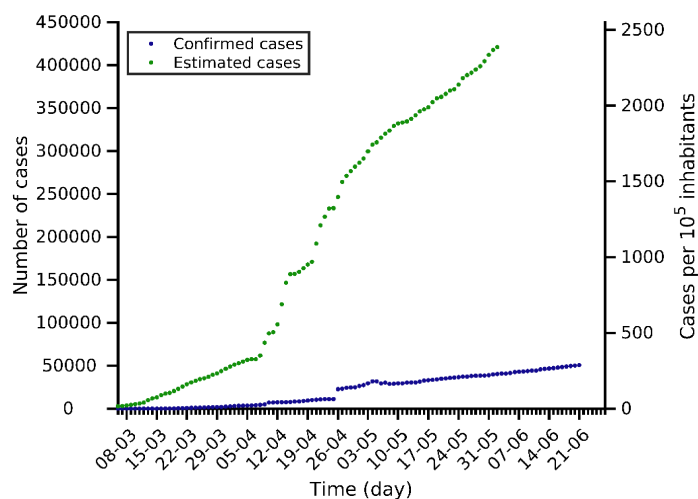
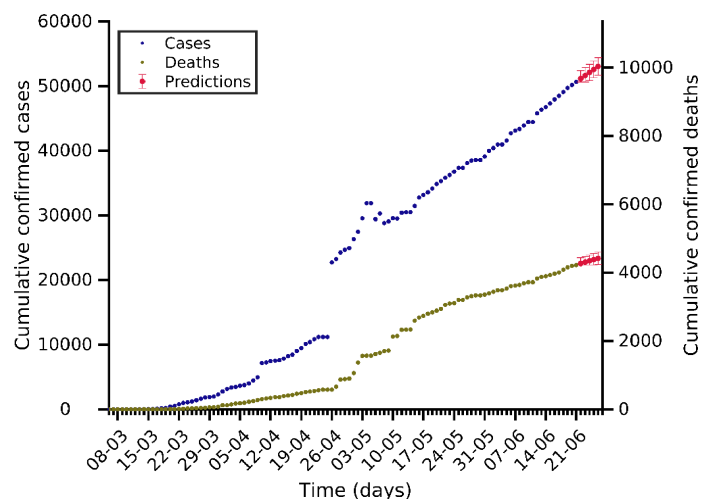
South Africa 21-06-2020. Population: 59.3M. Current cumulative incidence: 164/10⁵

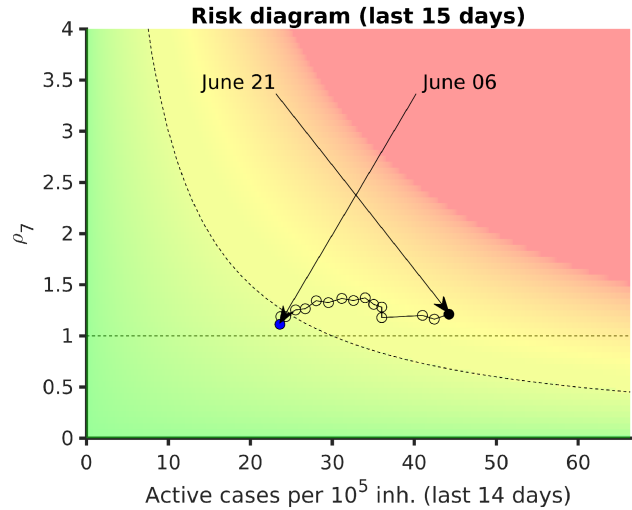
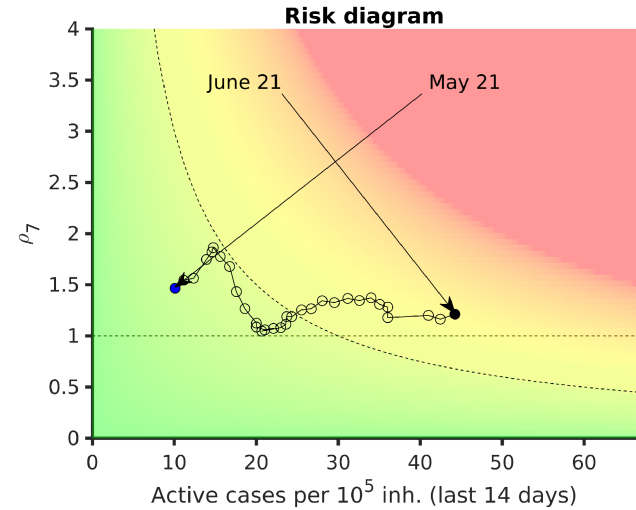
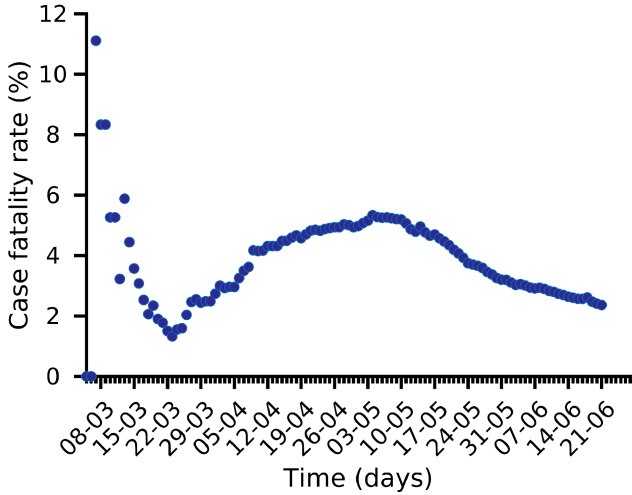
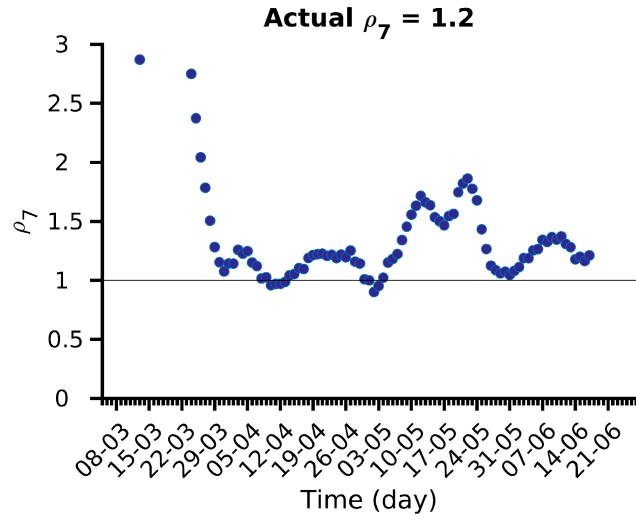
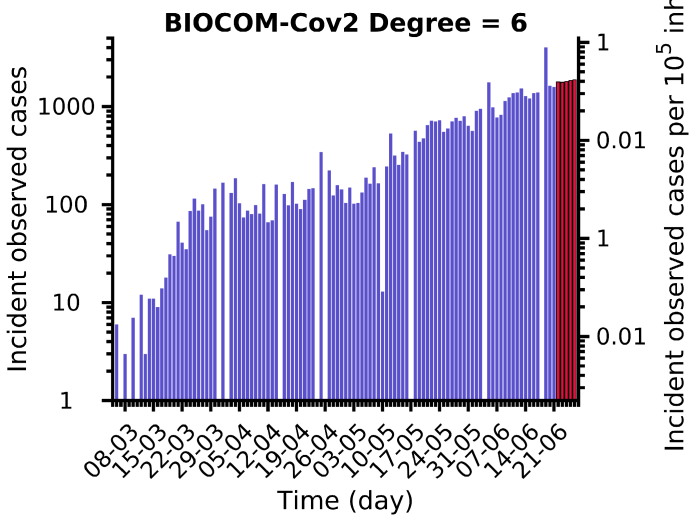
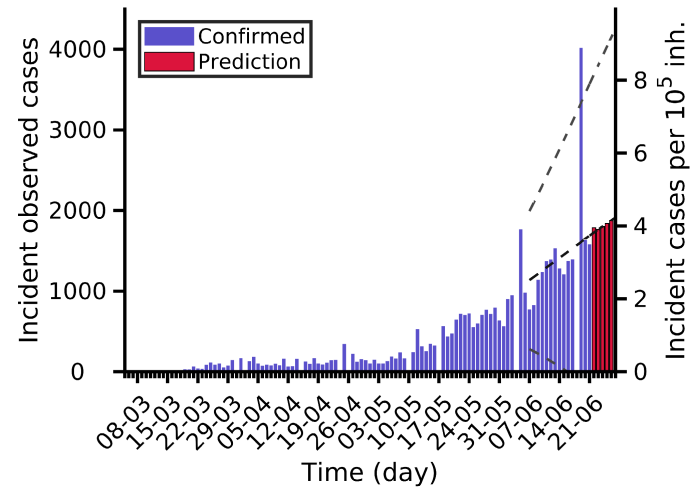
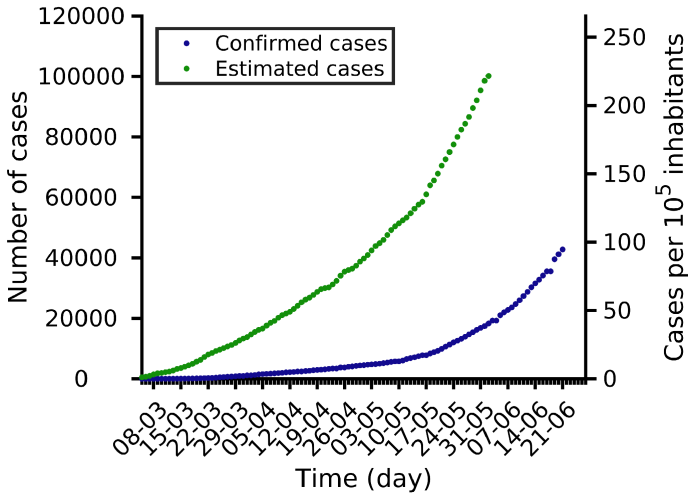
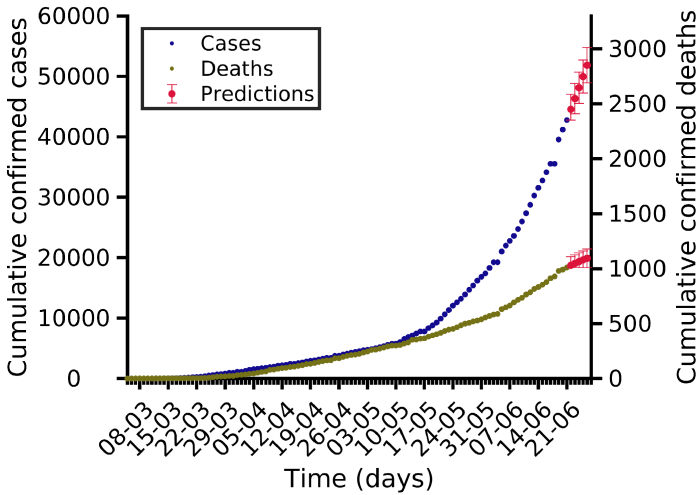




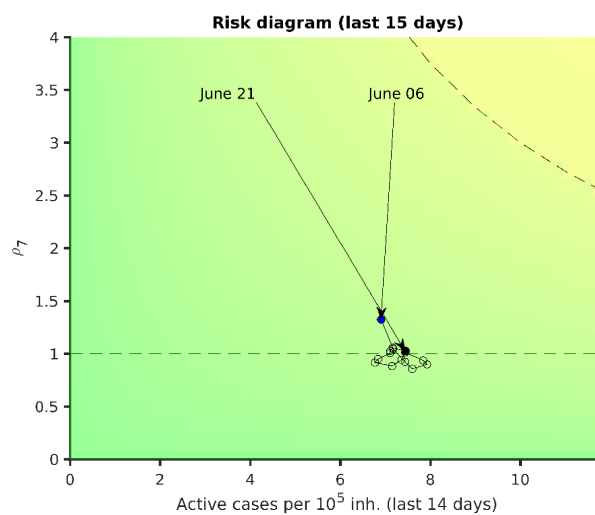
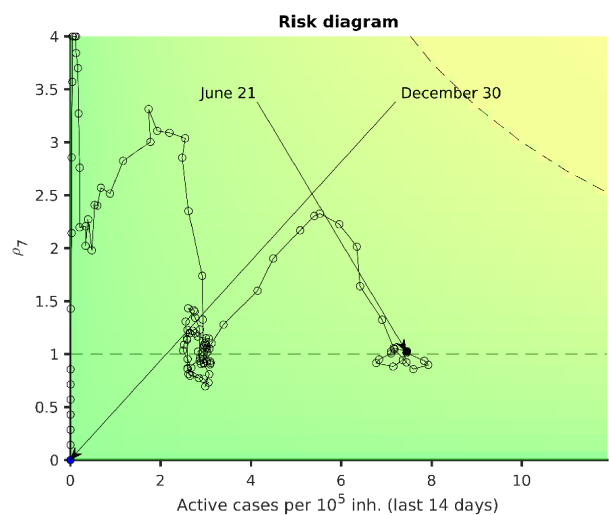
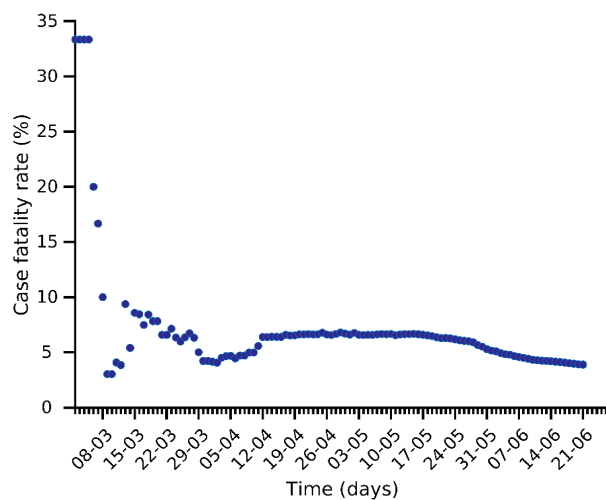
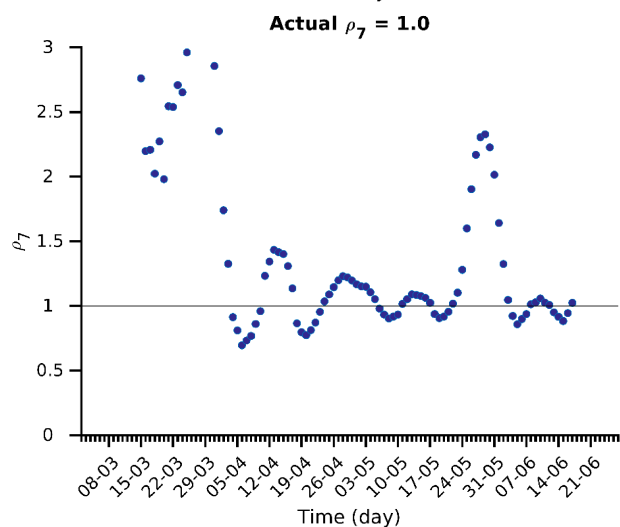
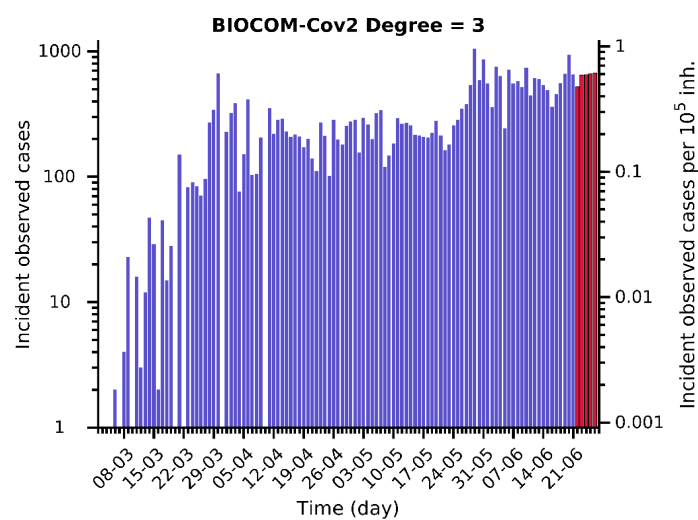
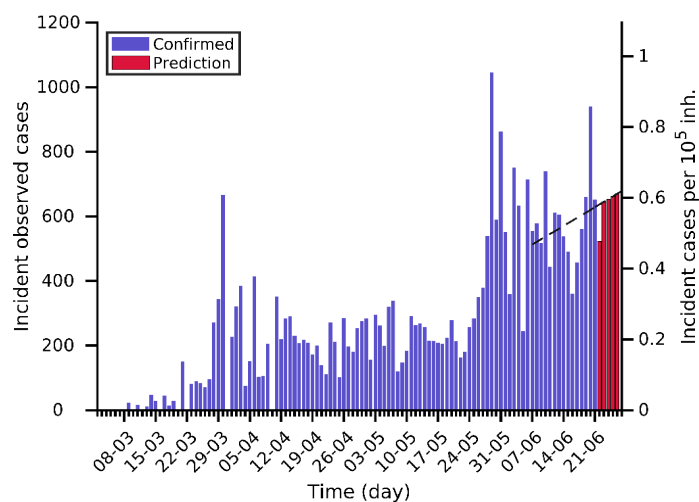
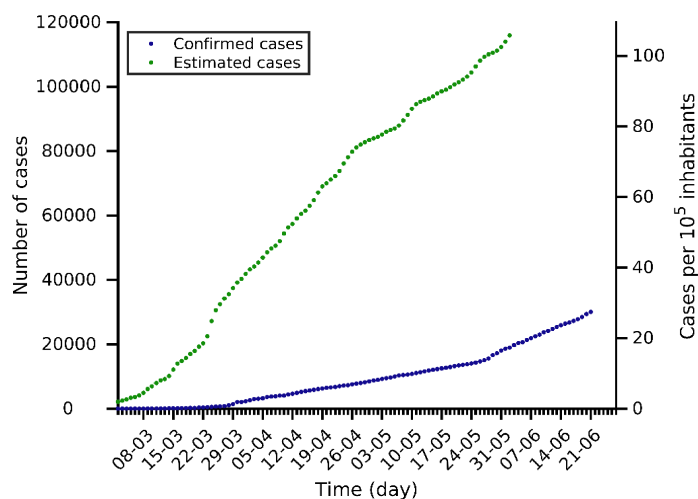
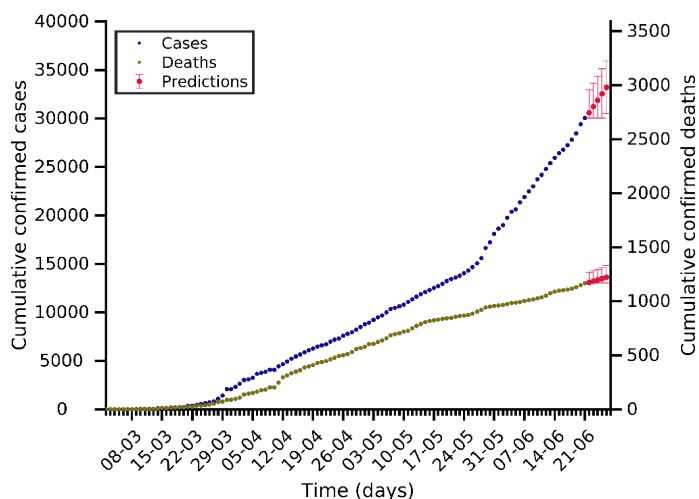


Ecuador 21-06-2020. Population: 17.6M. Current cumulative incidence: 287/10⁵

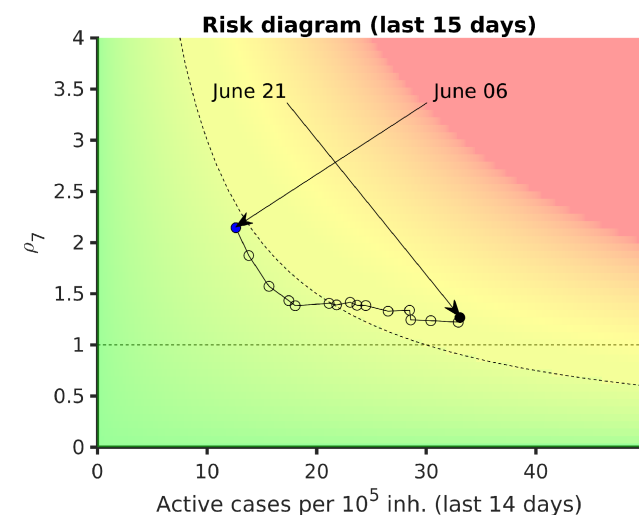
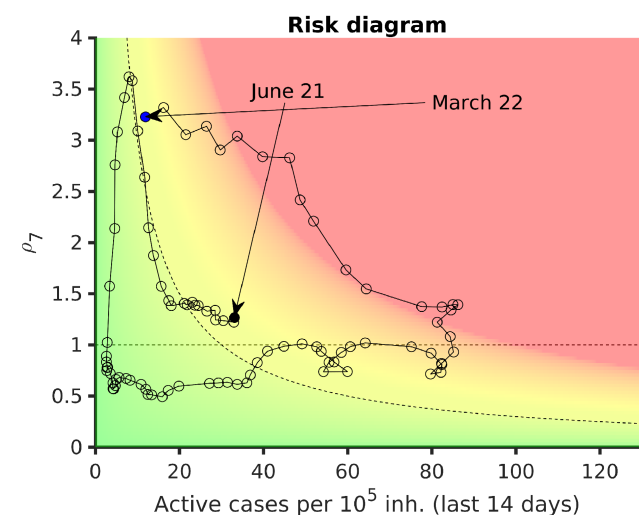
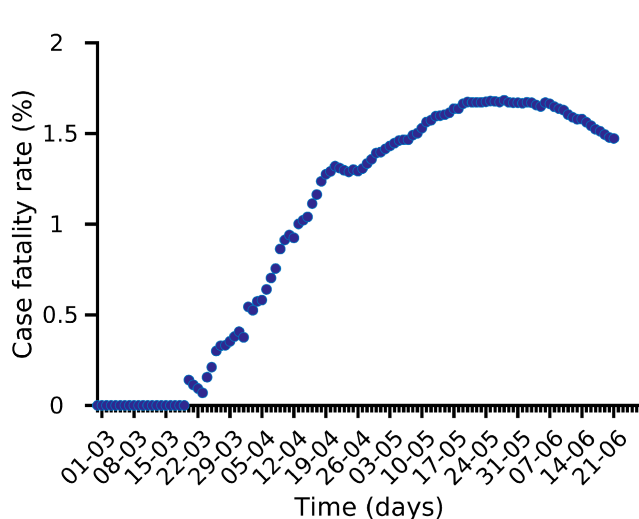
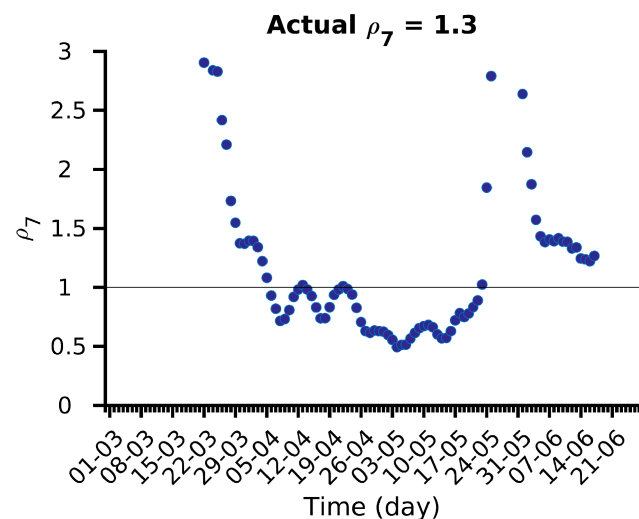
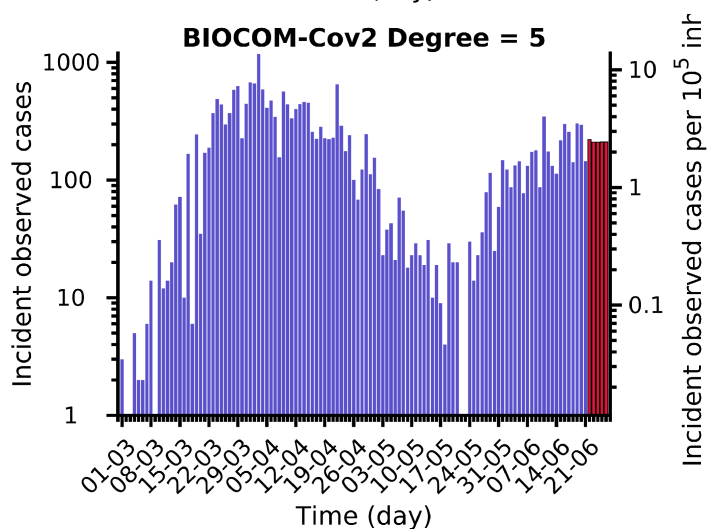
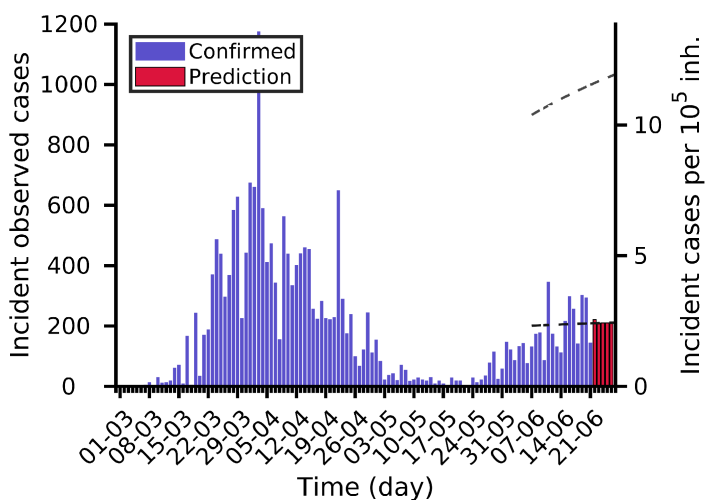
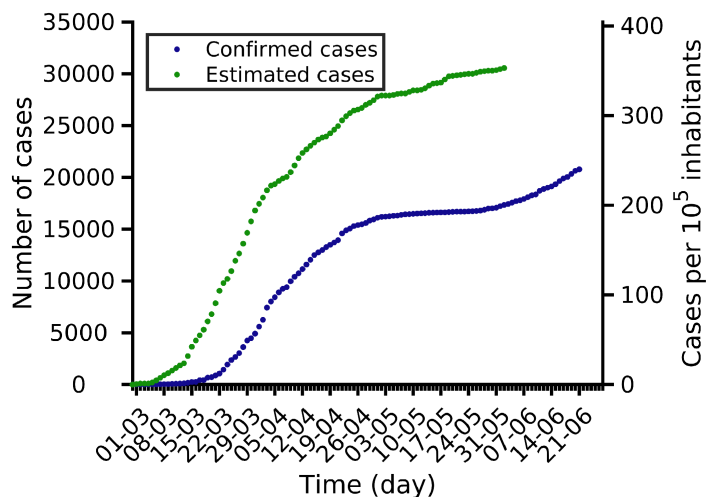
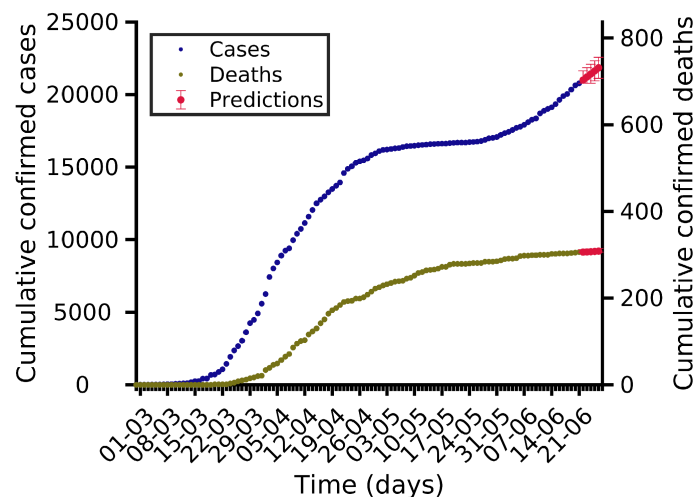




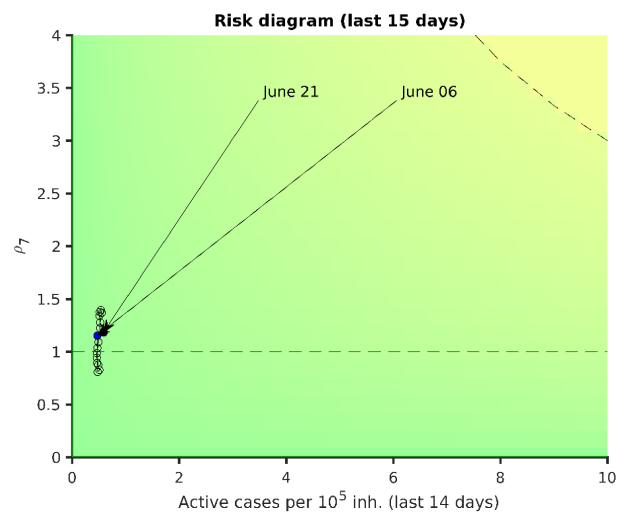
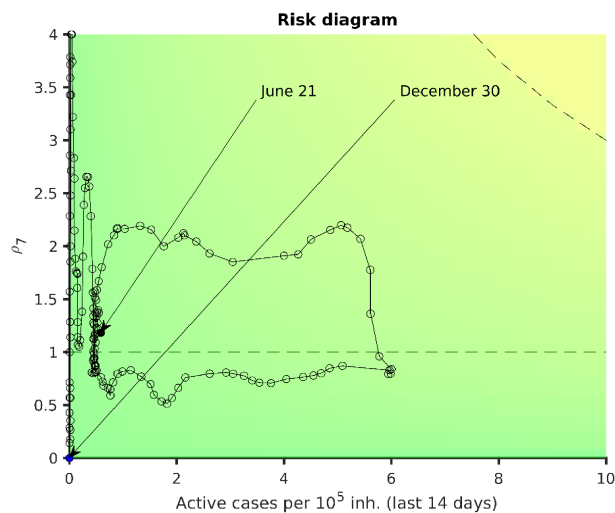
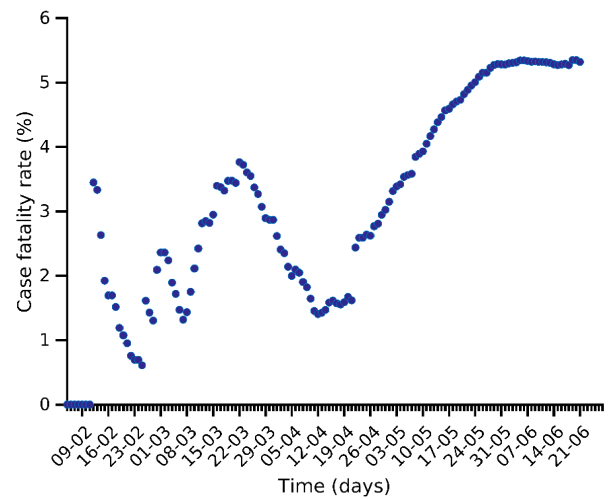
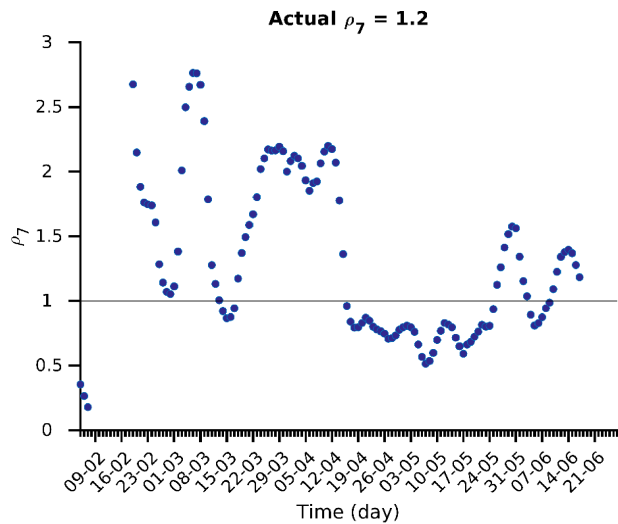
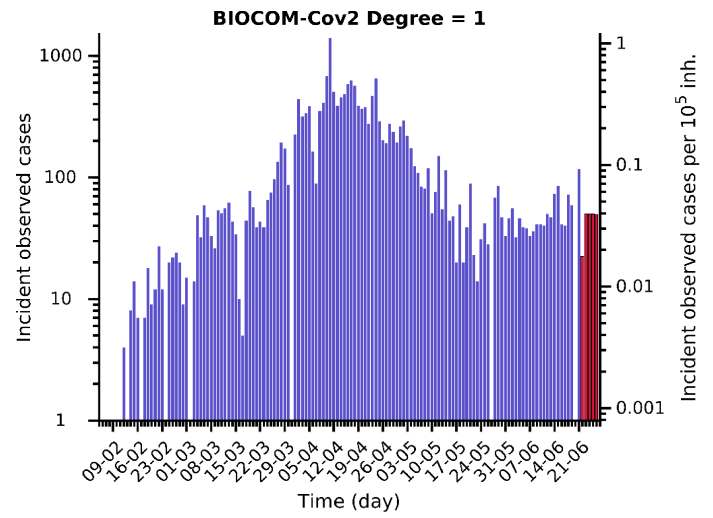
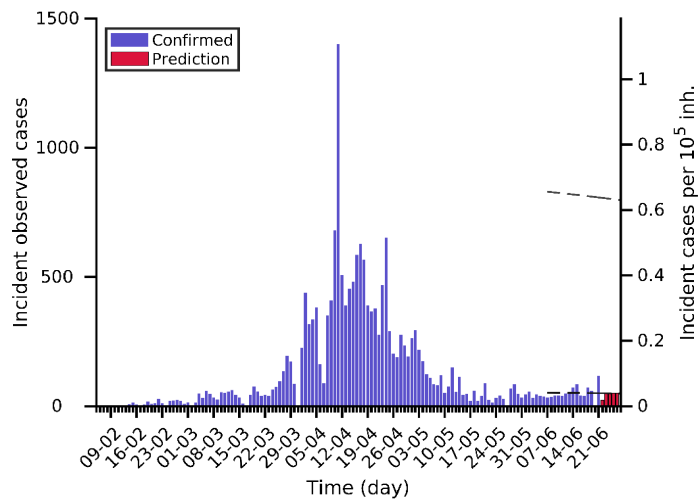
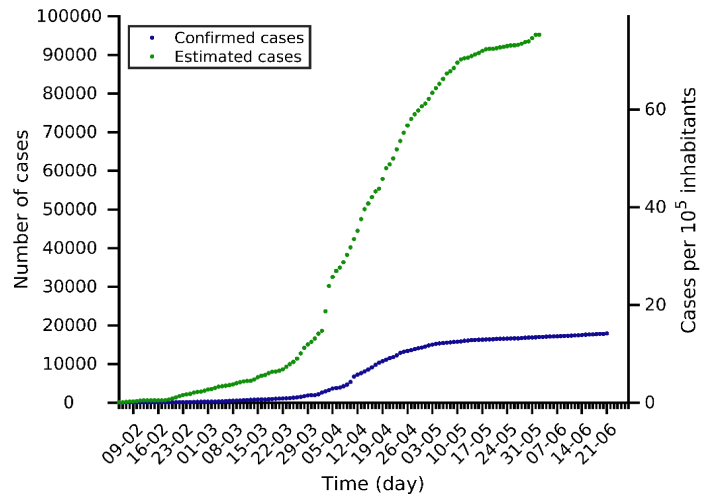
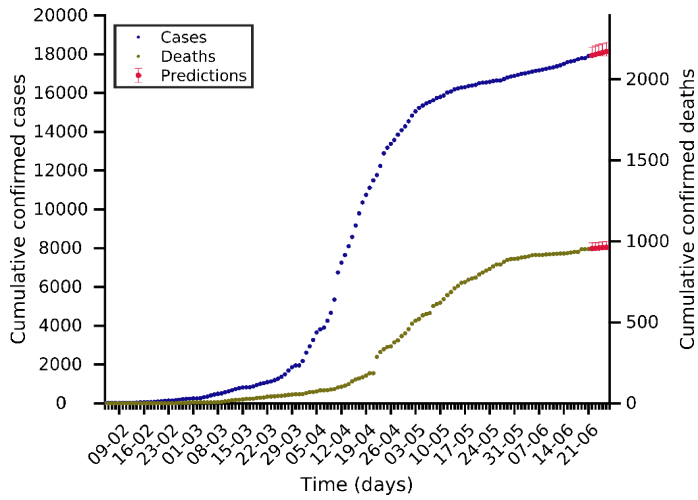
Philippines 21-06-2020. Population: 109.6M. Current cumulative incidence: 27/10⁵



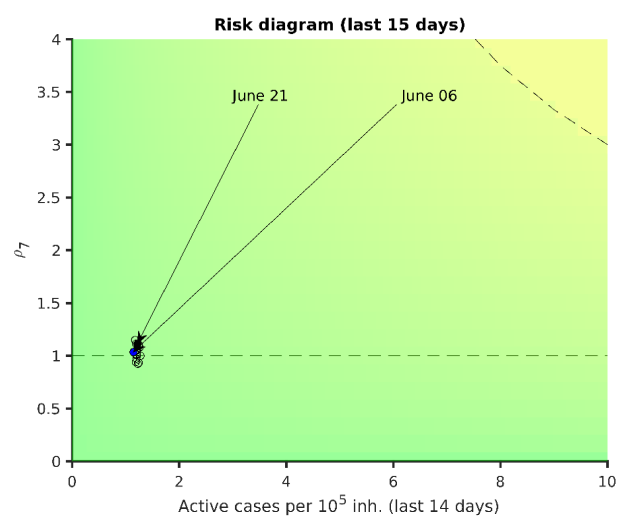
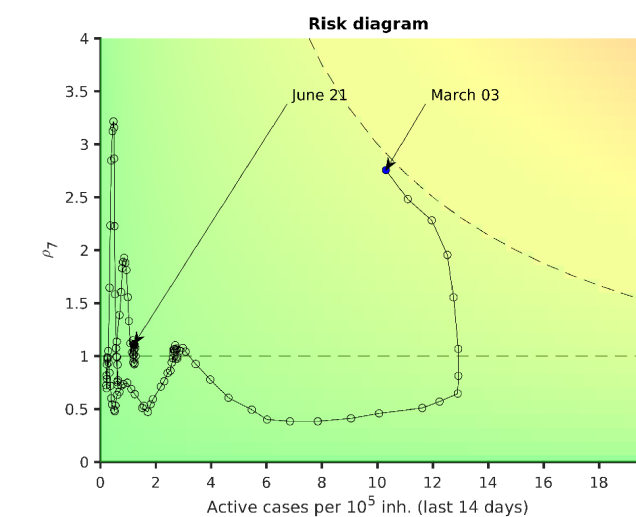
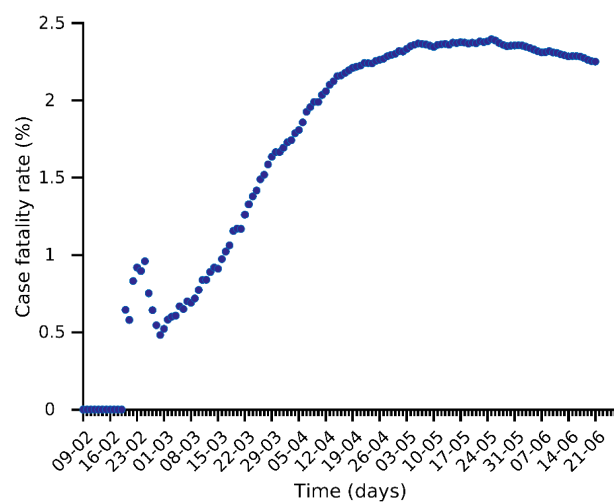
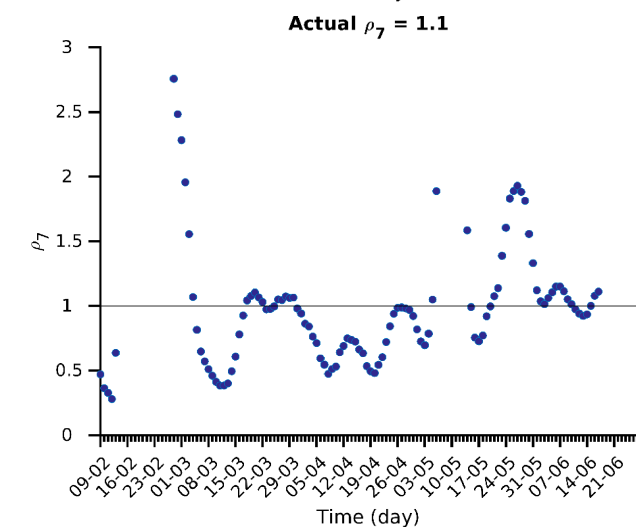
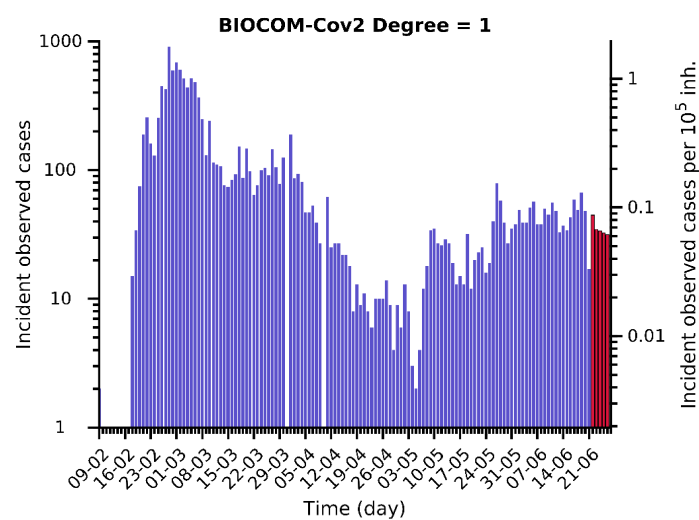
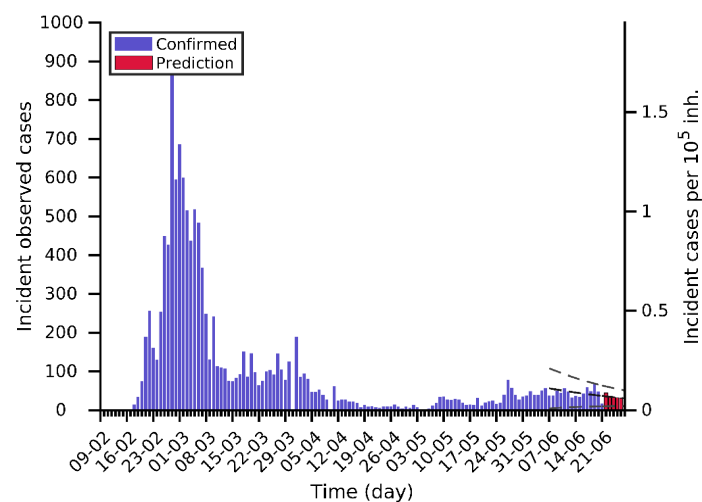
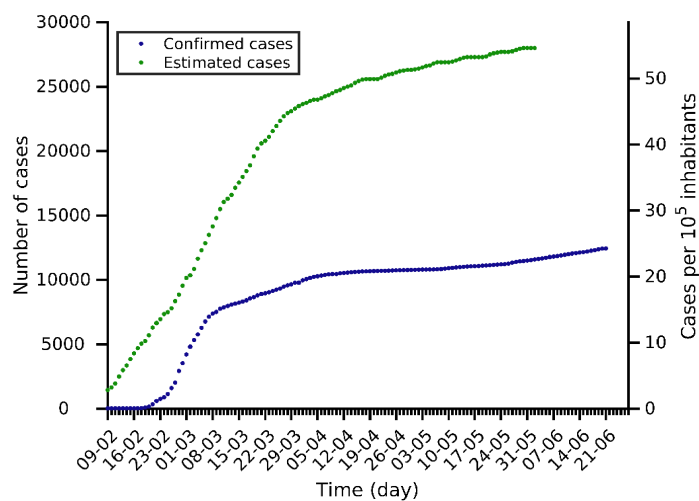
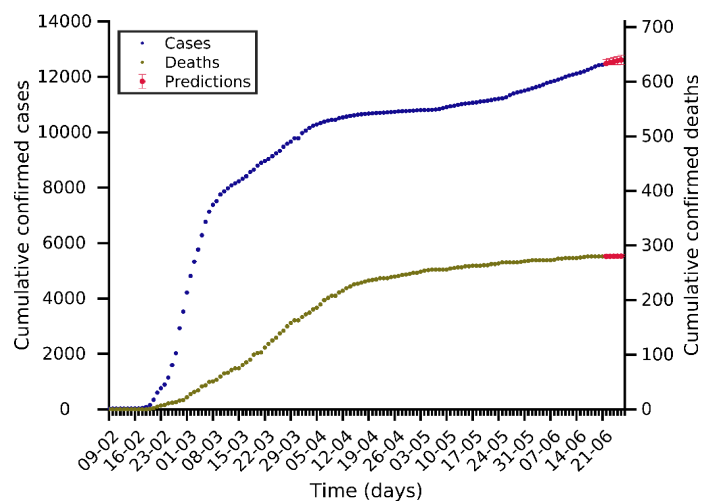
Israel 21-06-2020. Population: 8.7M. Current cumulative incidence: 240/10⁵



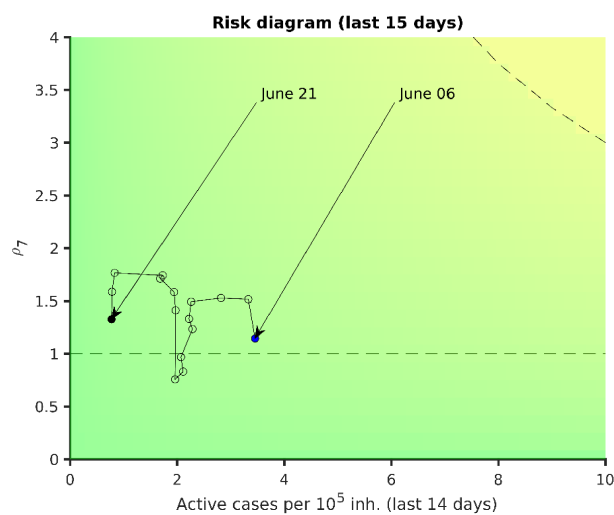
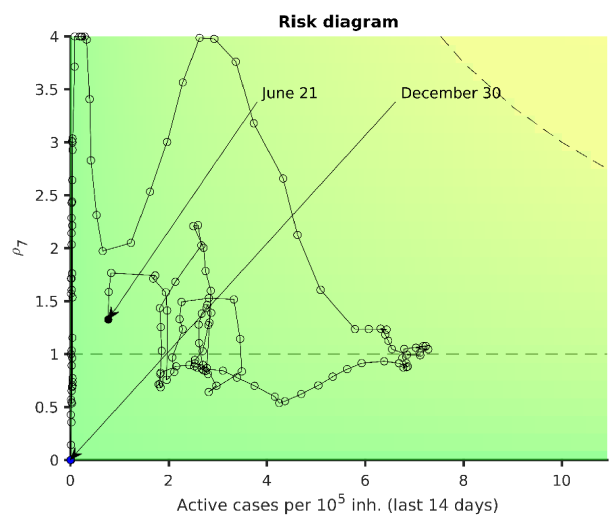
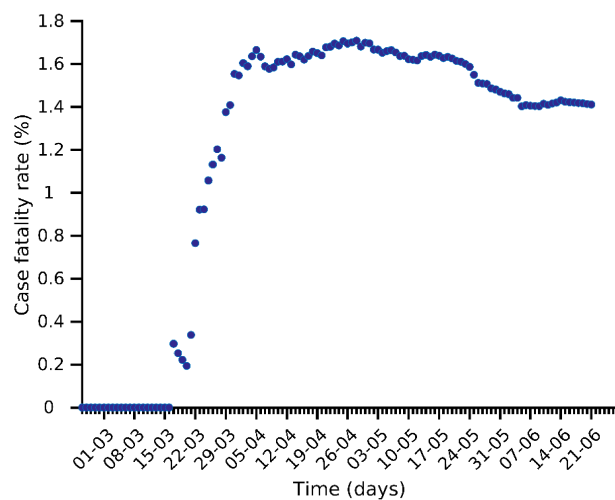
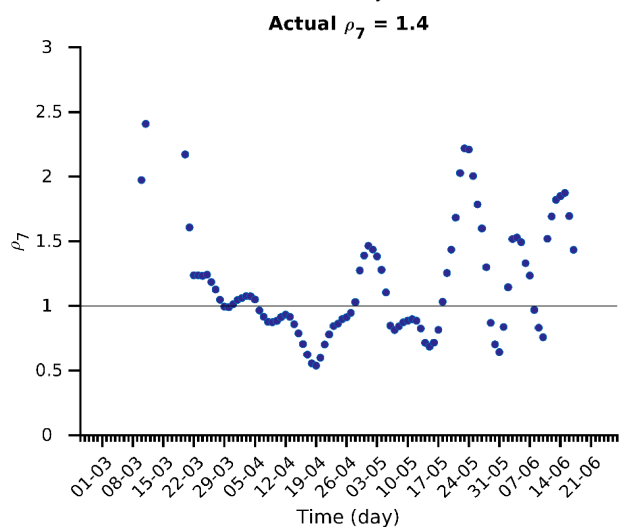
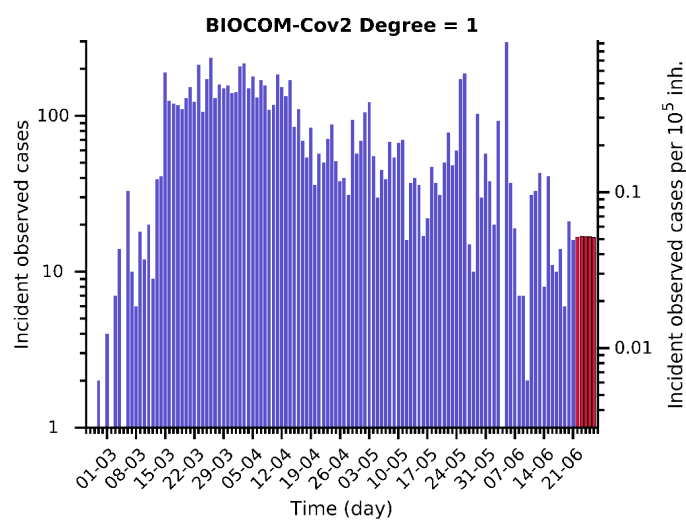
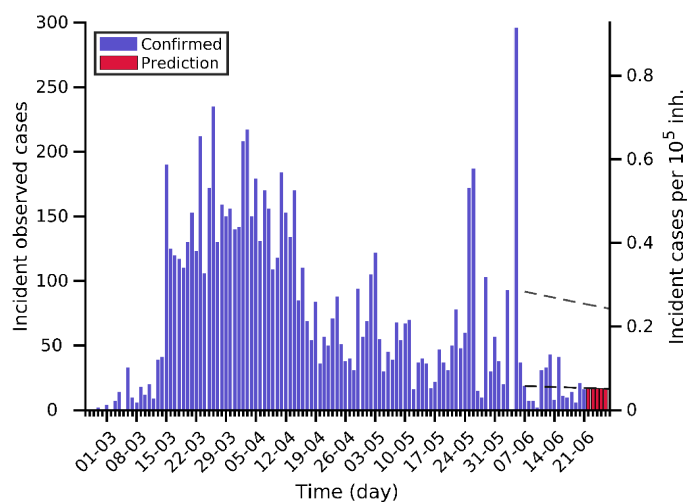
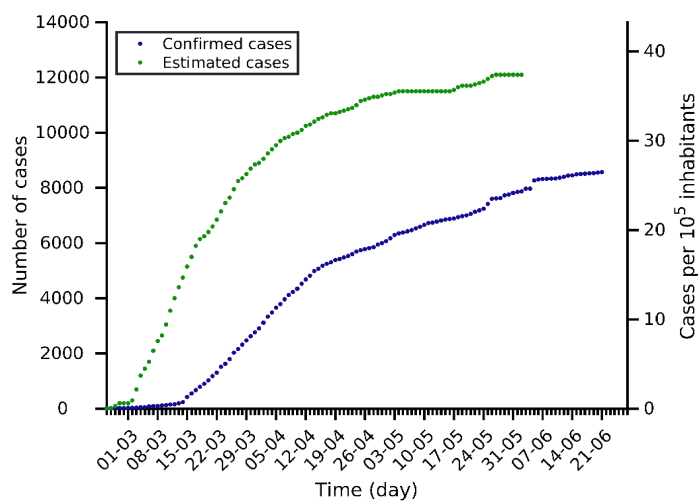
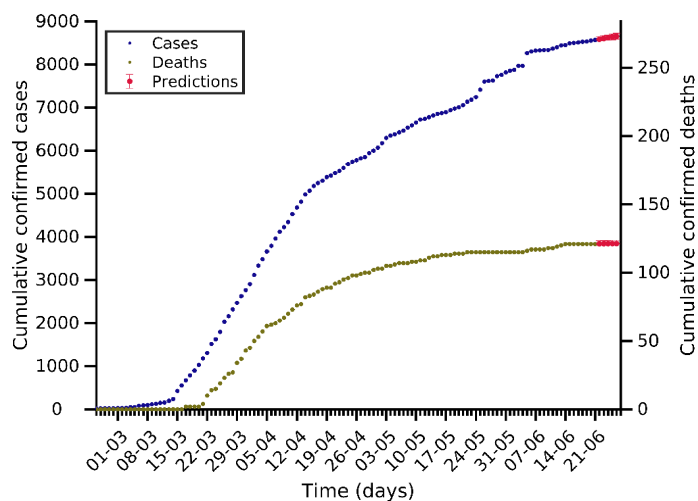
Japan 21-06-2020. Population: 126.5M. Current cumulative incidence: 14/10⁵



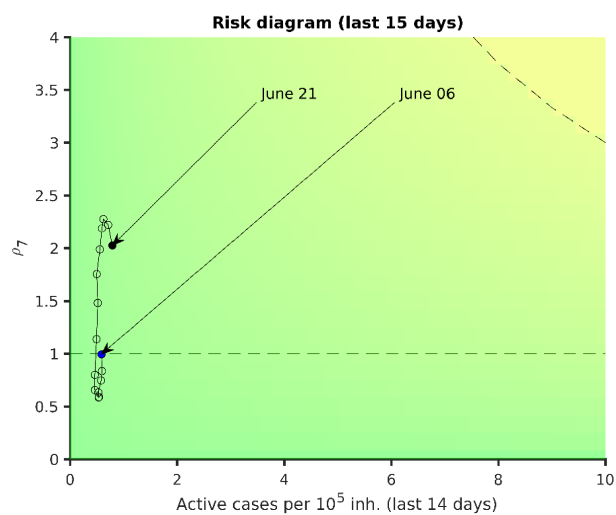
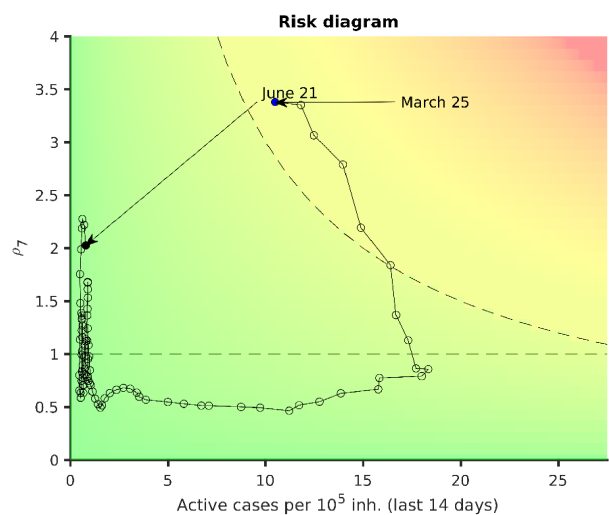
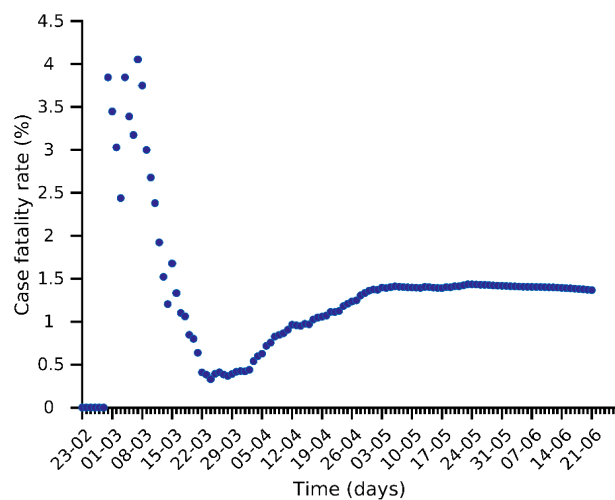
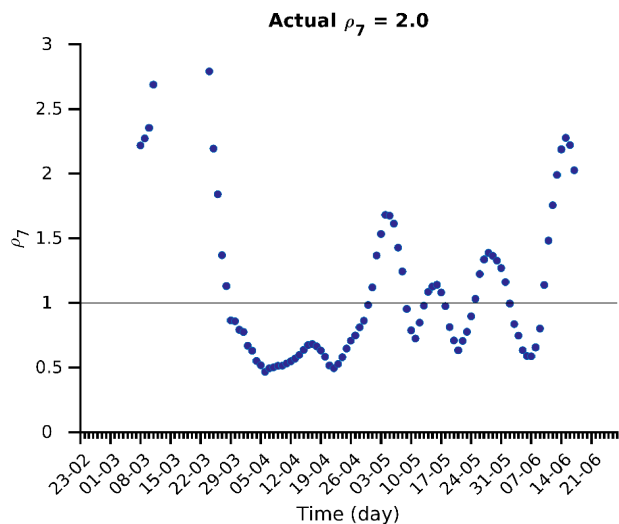
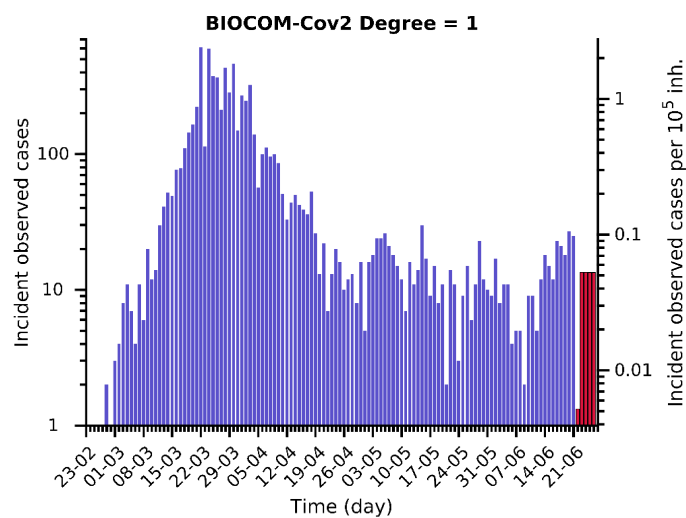
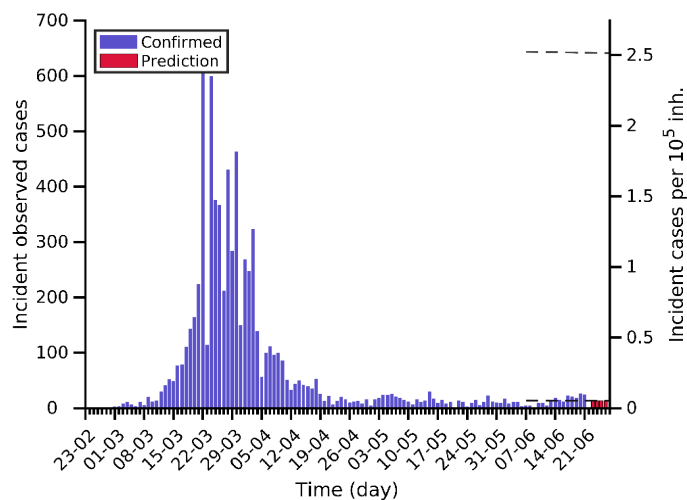
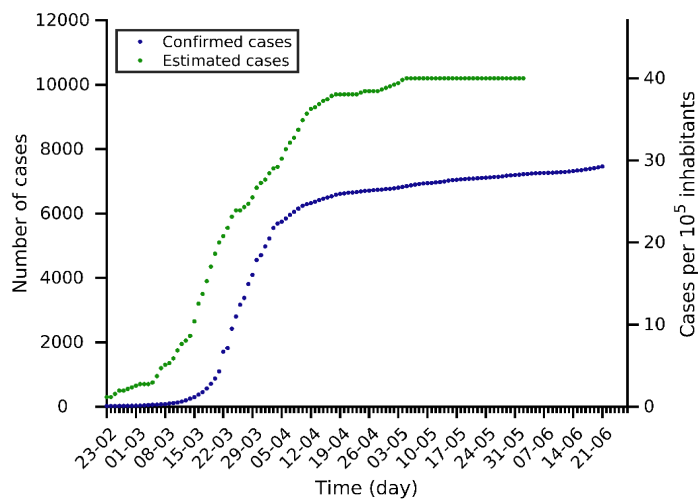
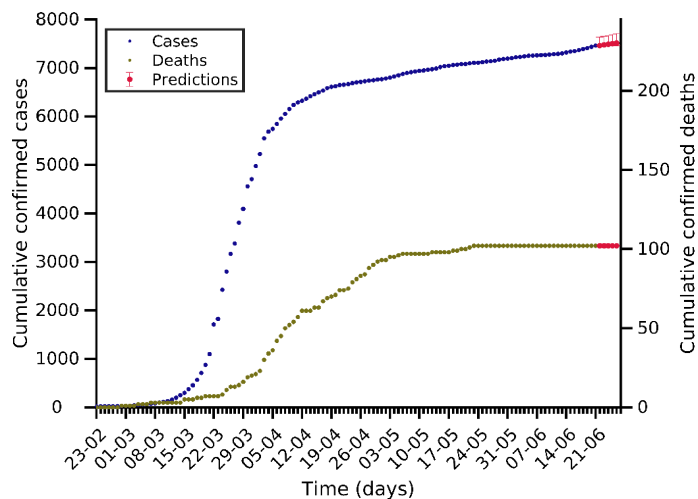
South Korea 21-06-2020. Population: 51.3M. Current cumulative incidence: 24/10⁵

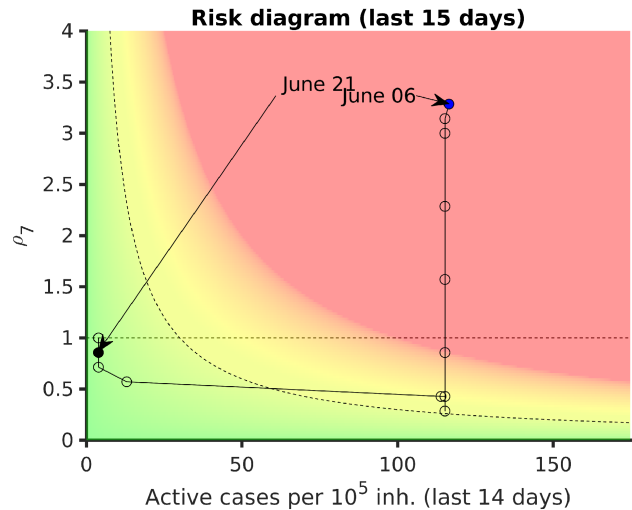
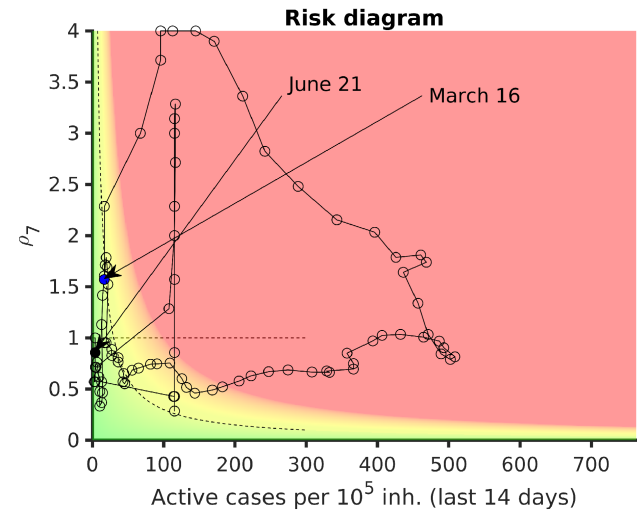
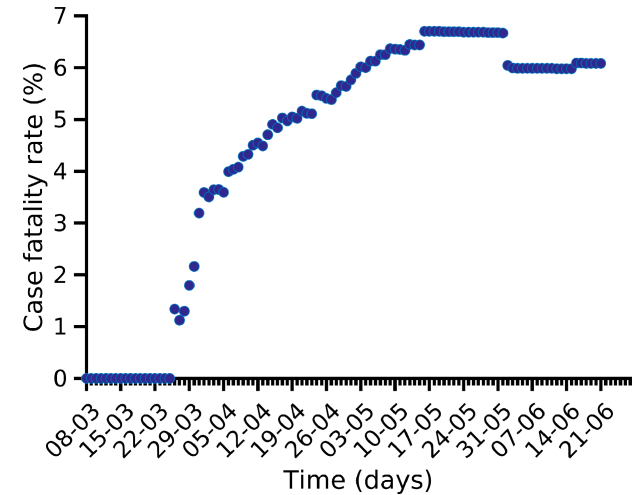
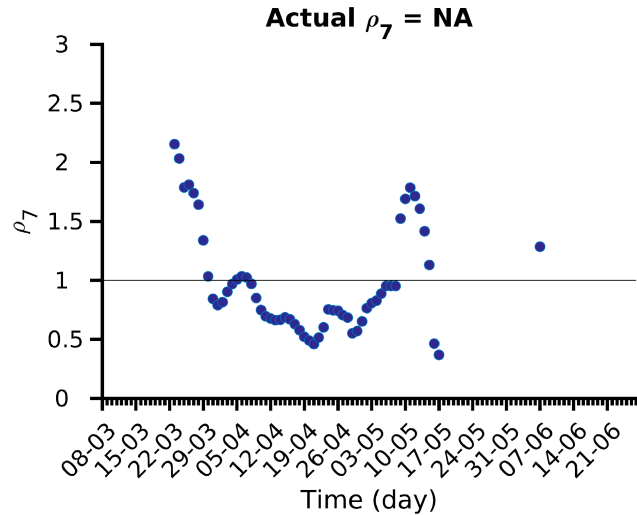
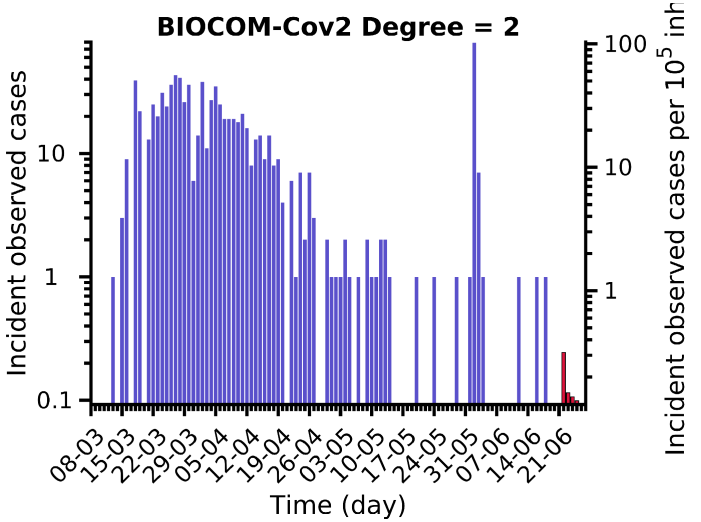
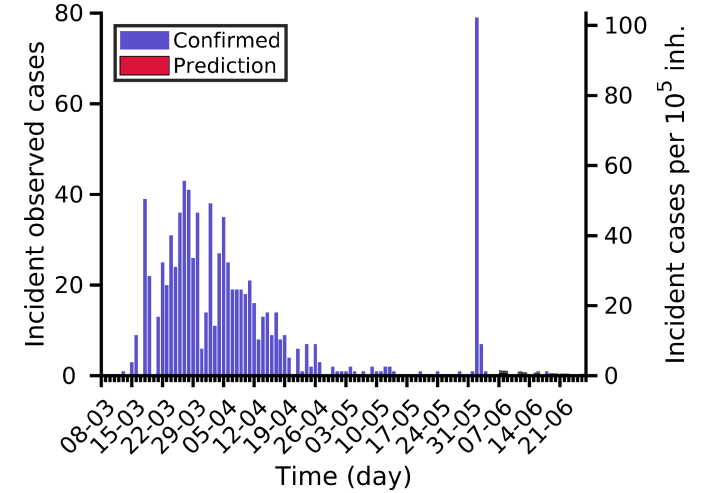
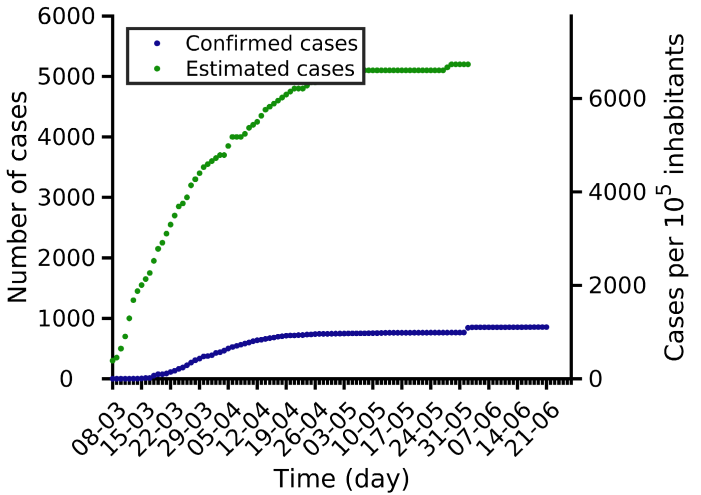
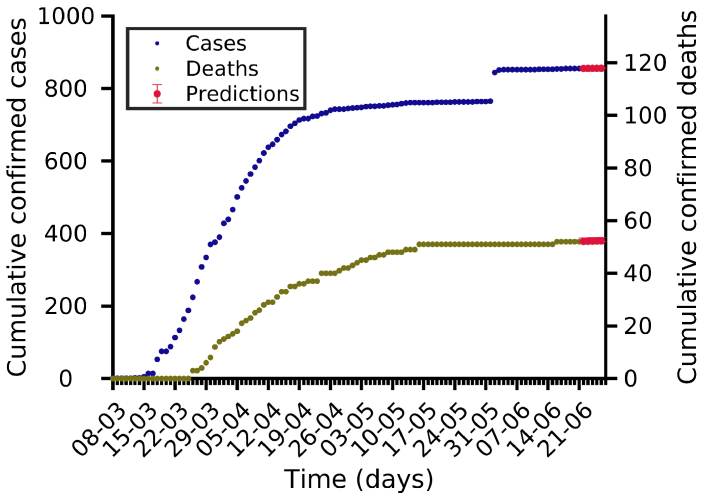


Malaysia 21-06-2020. Population: 32.4M. Current cumulative incidence: 26/10⁵



Australia 21-06-2020. Population: 25.5M. Current cumulative incidence: 29/10⁵



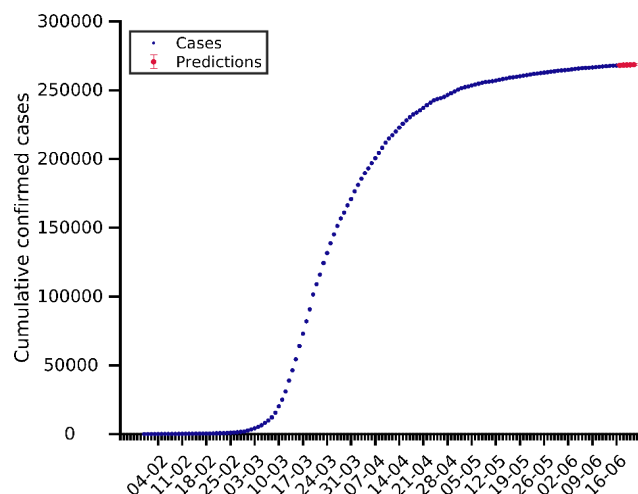


(3) Analysis and prediction of COVID-19 for Spain and its autonomous communities

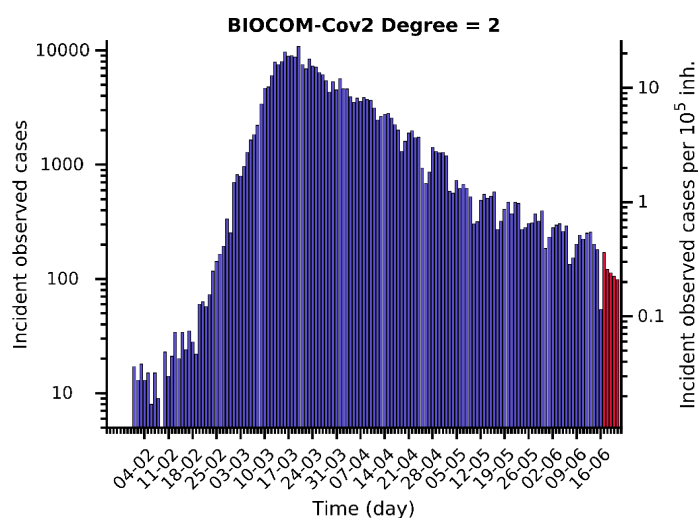
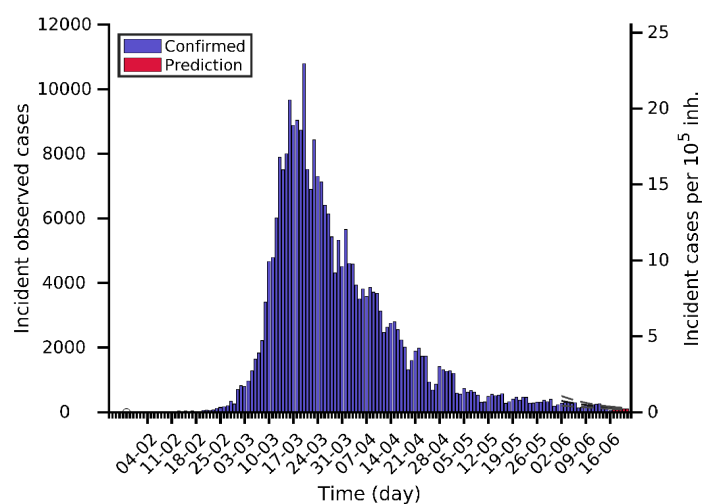
**Data updated on 22th June, data series built
with the day of the symptoms' onset, reliable
until 15th June.**

Data obtained from <https://github.com/datadista/datasets/tree/master/COVID%2019> and
<https://covid19.isciii.es/>

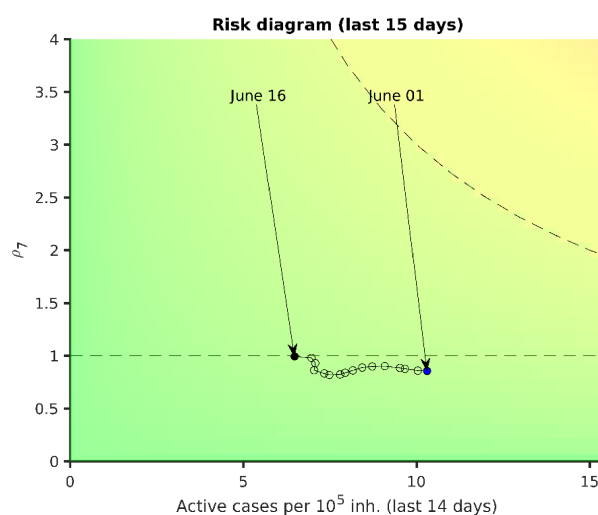
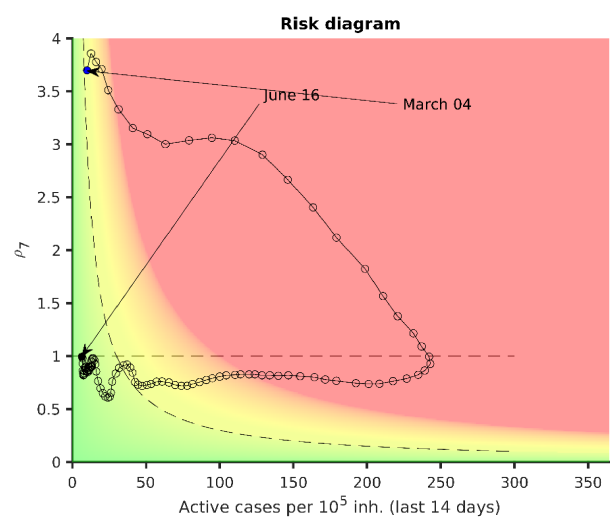
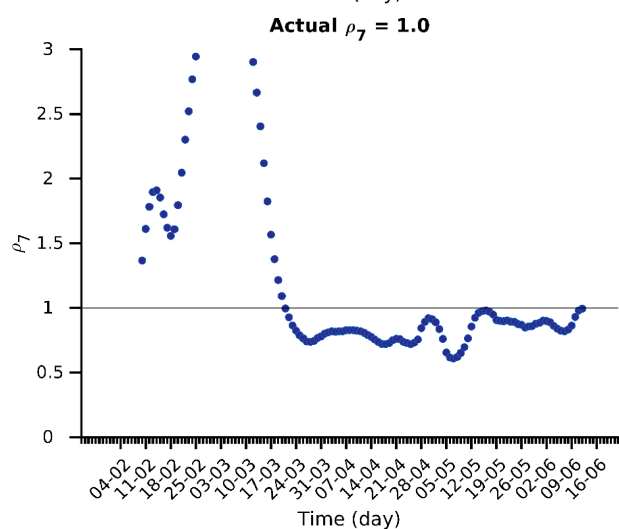
Spain 16-06-2020. Population: 47.0M. Current cumulative incidence: 570/10⁵



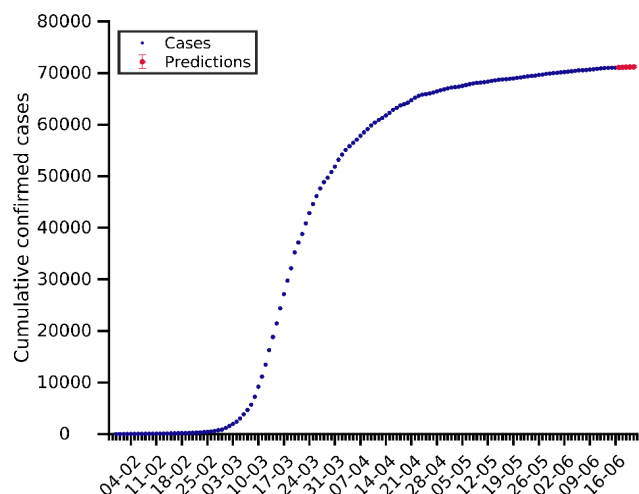
Deaths series currently under revision



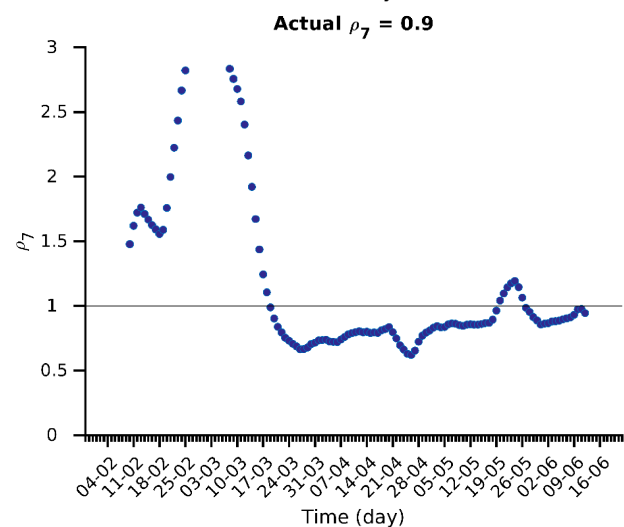
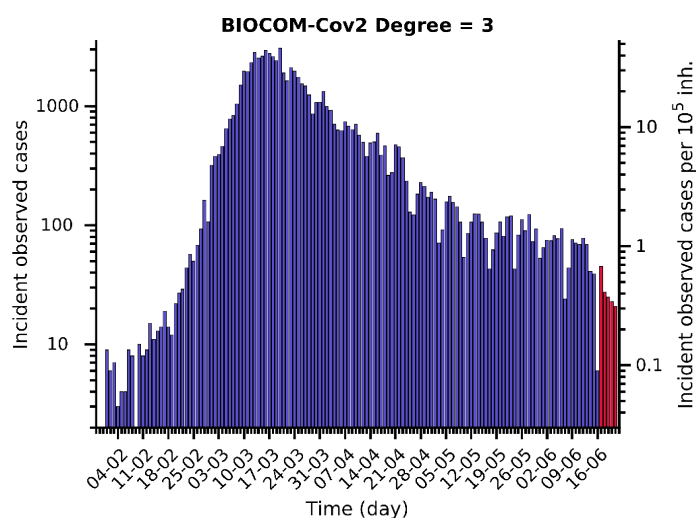
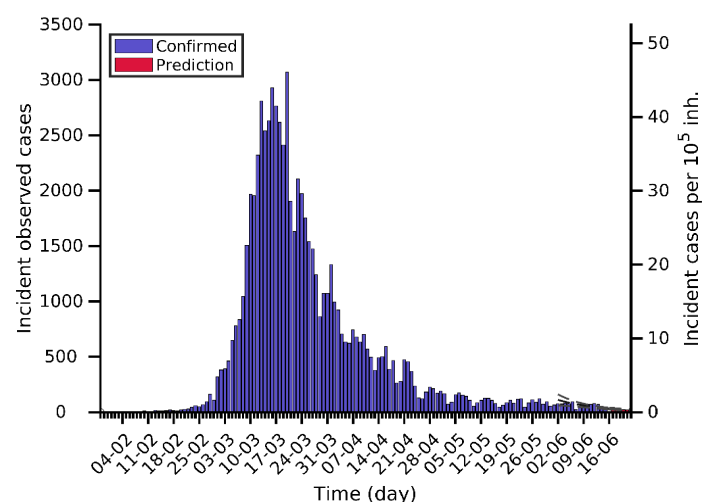
Deaths series currently under revision



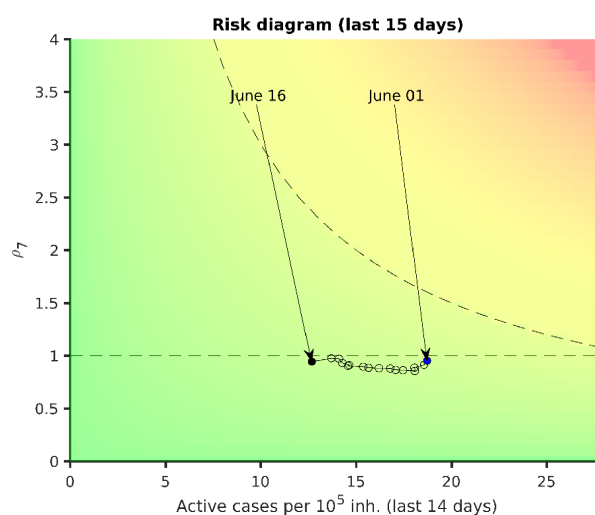
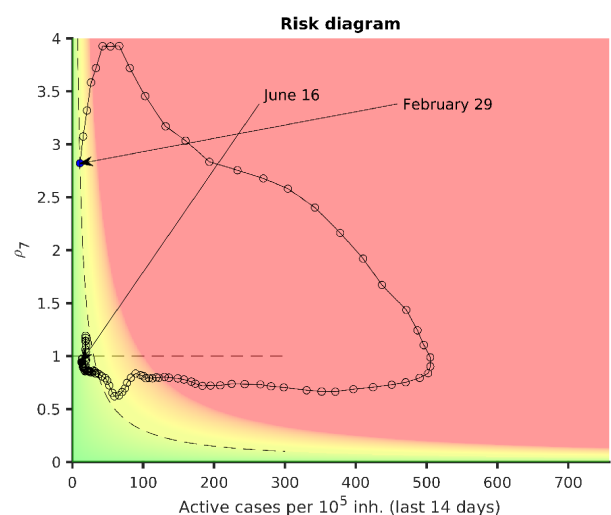
Madrid 16-06-2020. Population: 6.7M. Current cumulative incidence: 1066/10⁵



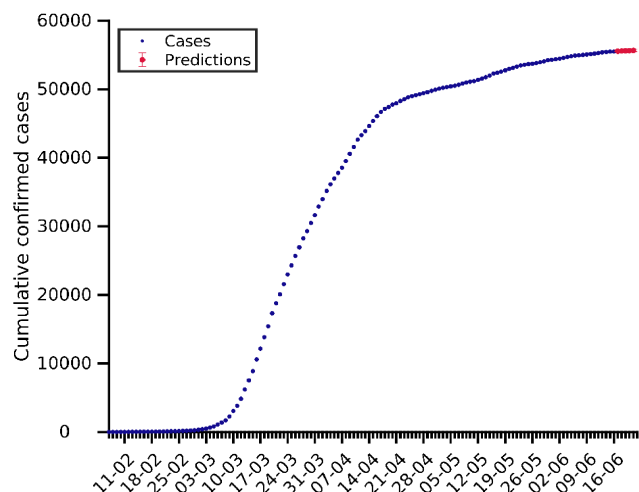
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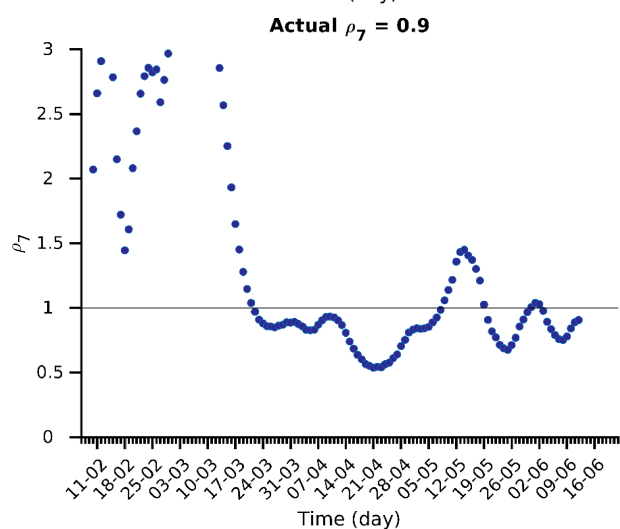
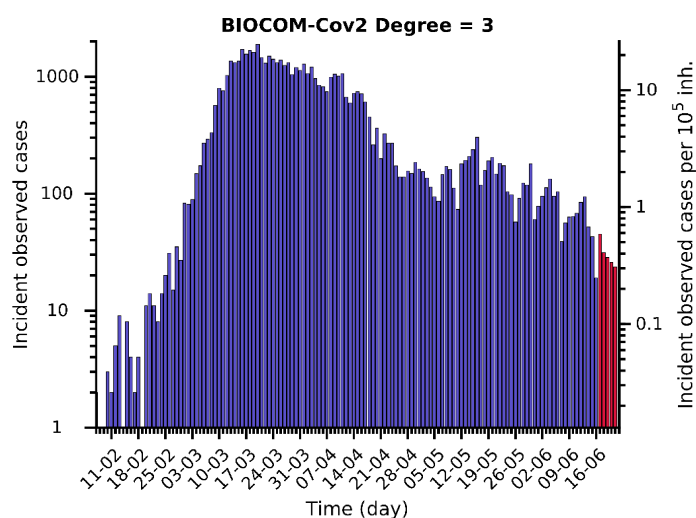
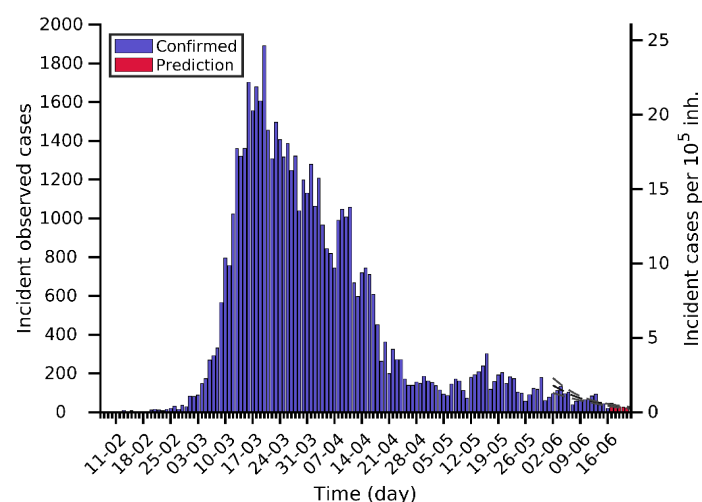
Deaths series currently under revision



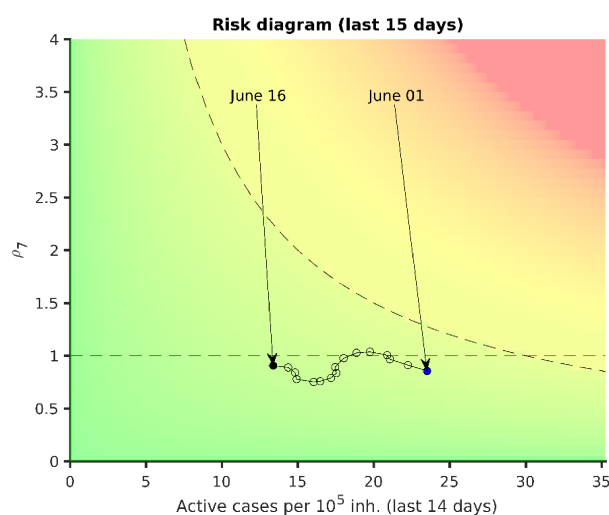
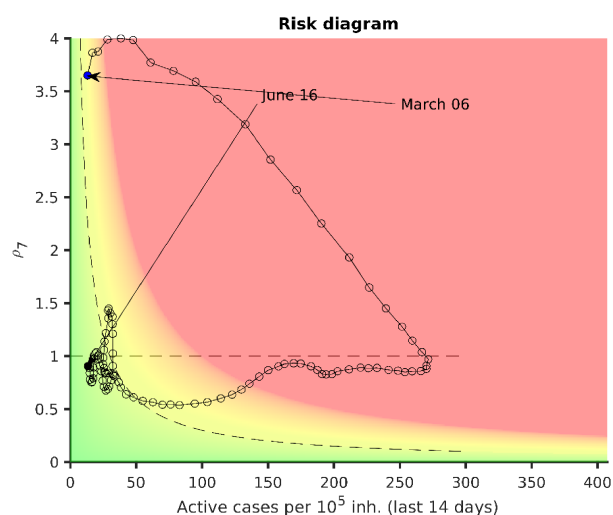
Catalunya 16-06-2020. Population: 7.7M. Current cumulative incidence: 723/10⁵

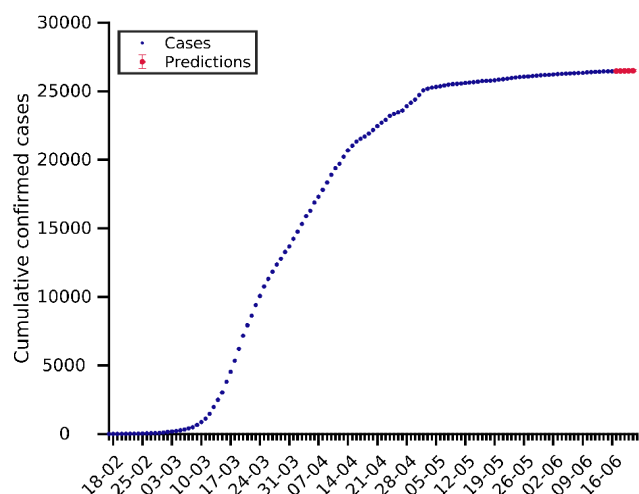


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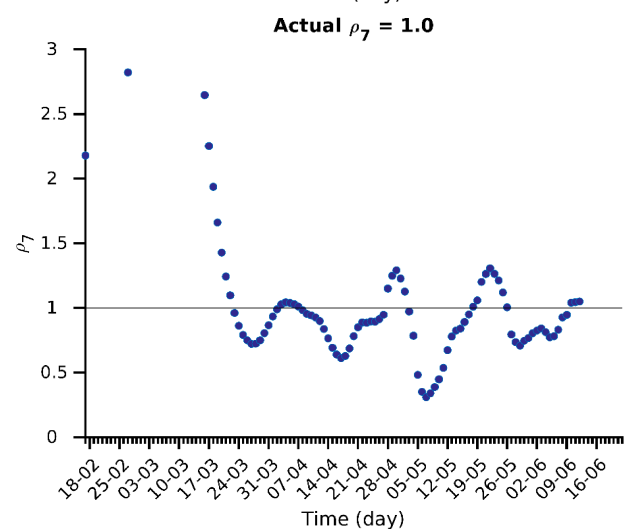
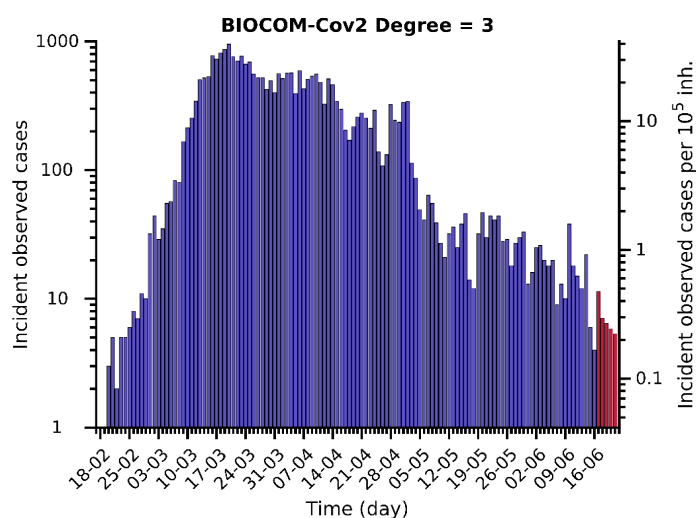
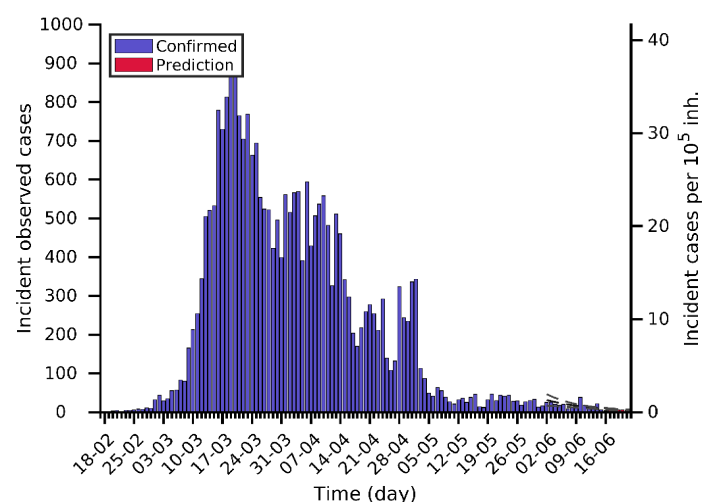


Deaths series currently under revision

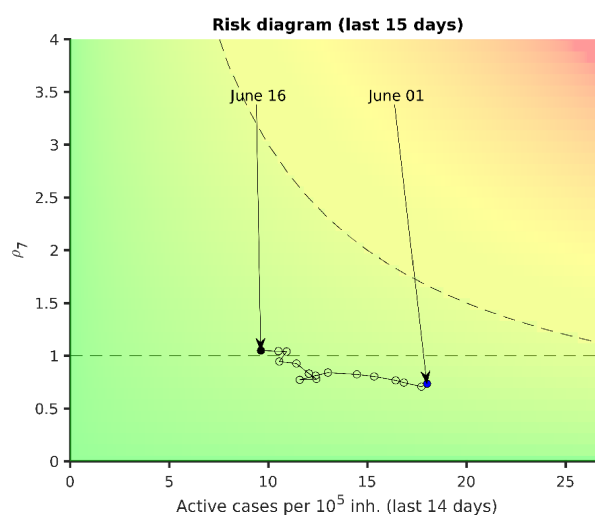
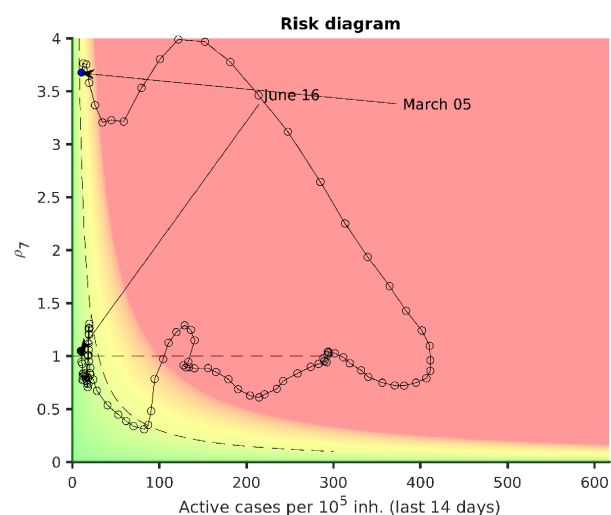


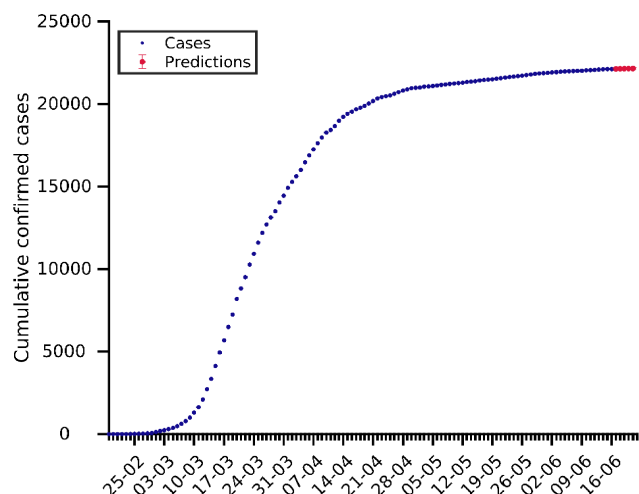


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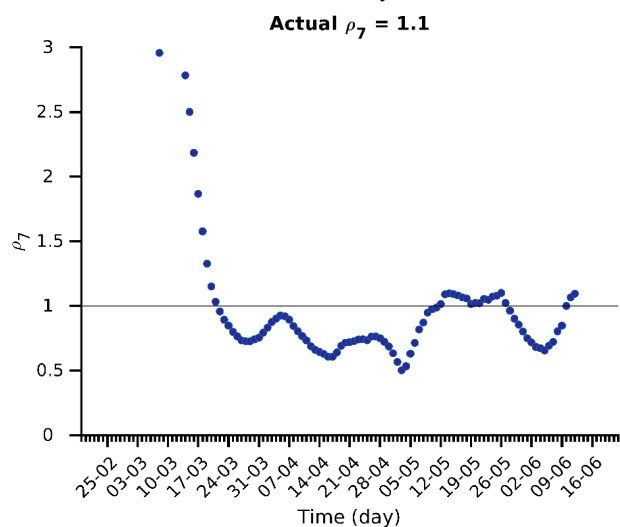
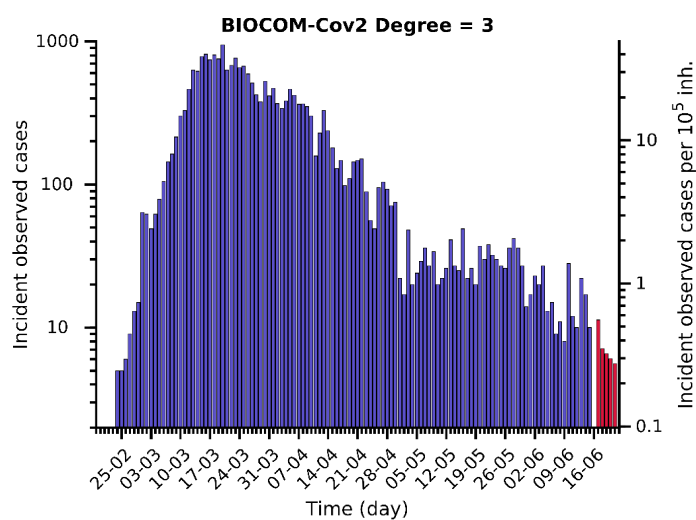
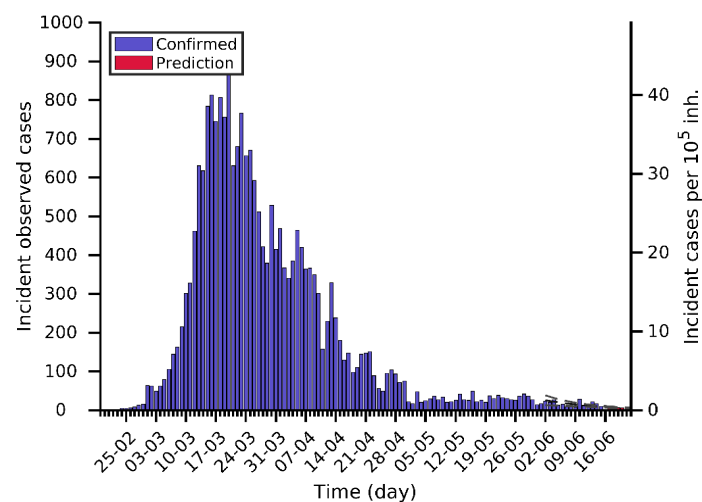


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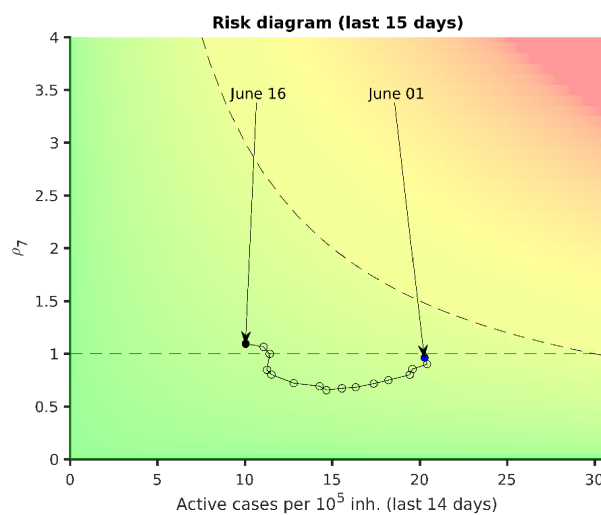
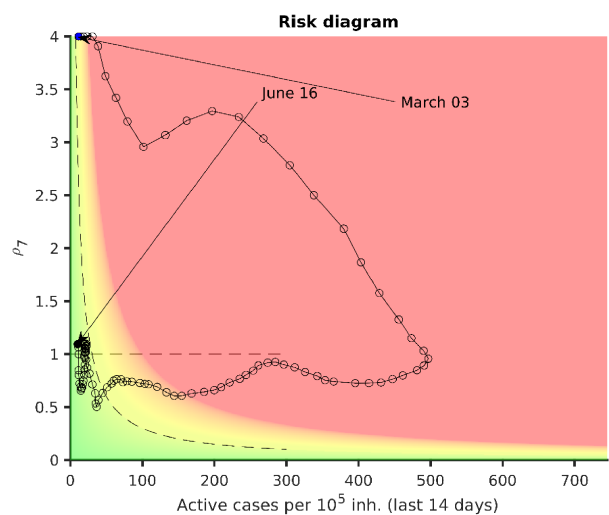




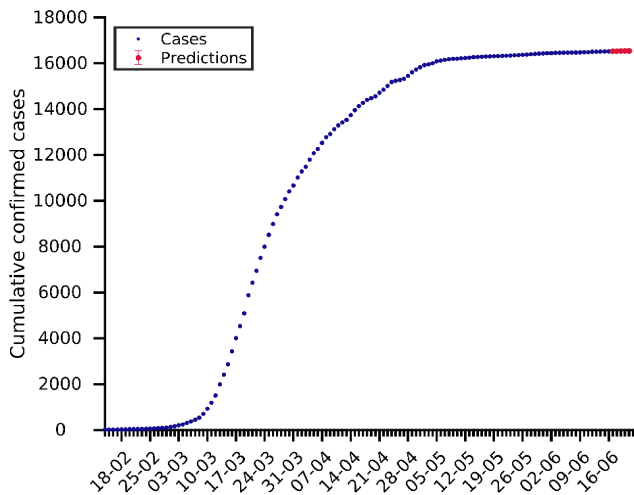
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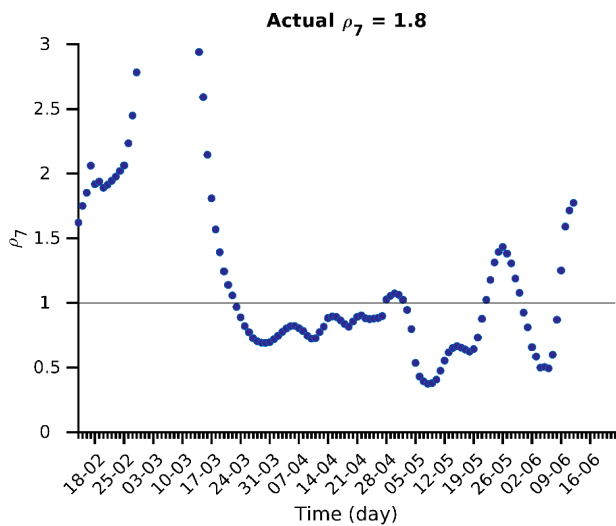
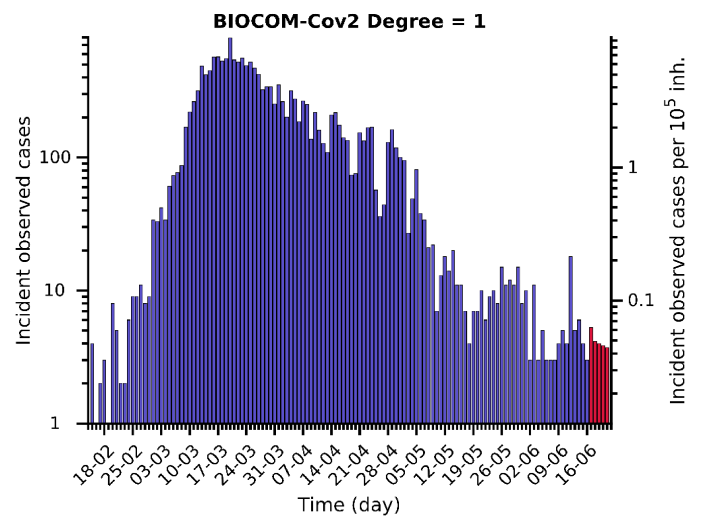
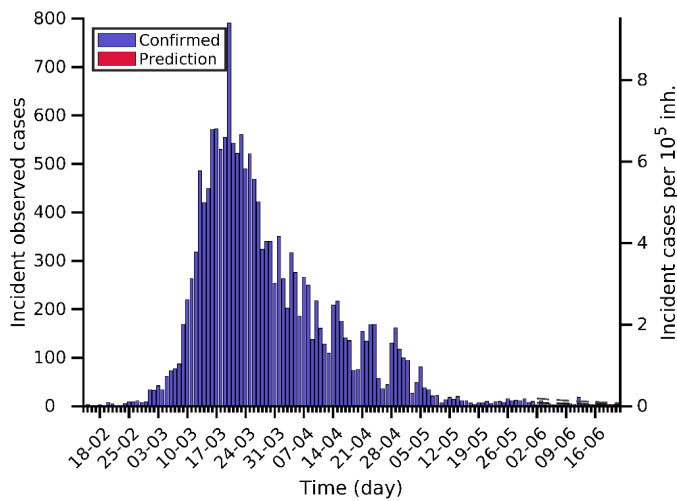
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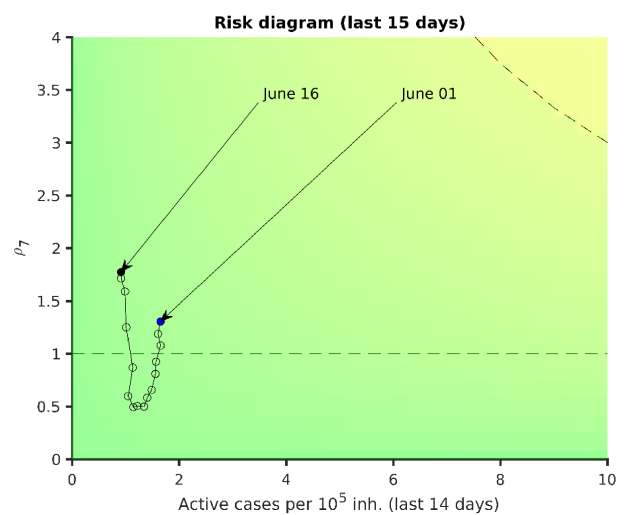
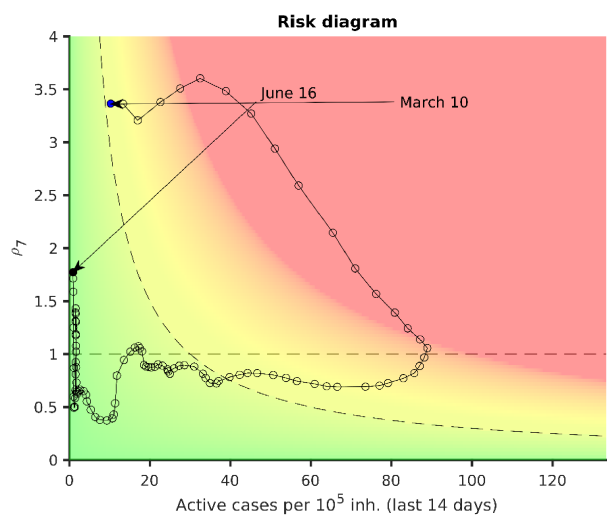
Andalucia 16-06-2020. Population: 8.4M. Current cumulative incidence: 196/10⁵



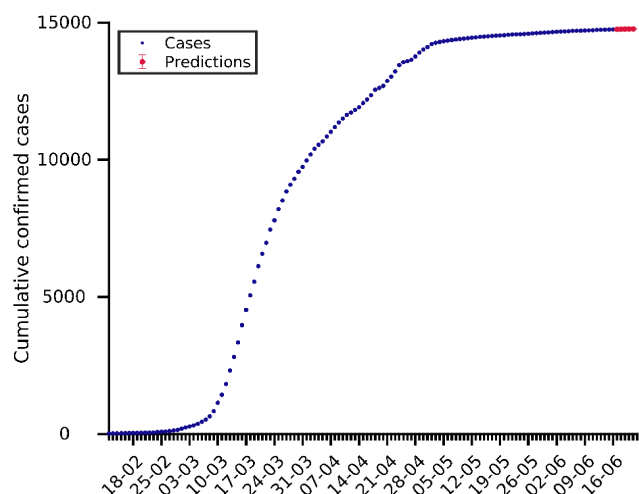
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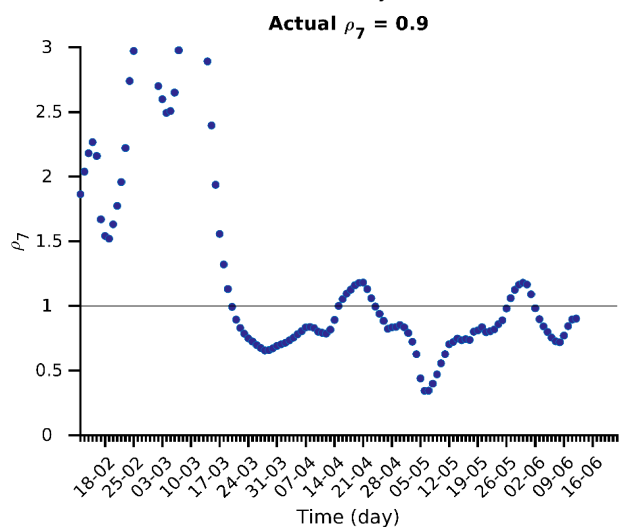
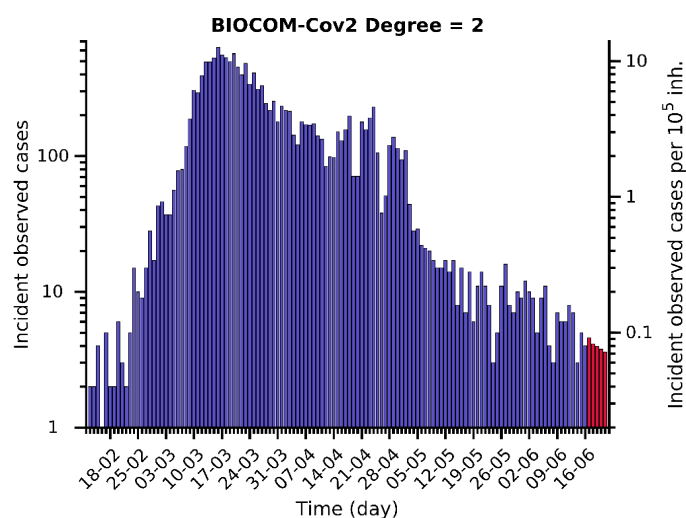
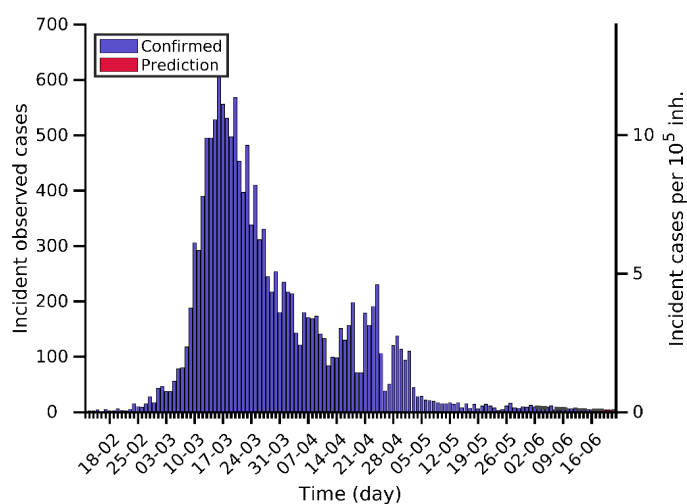
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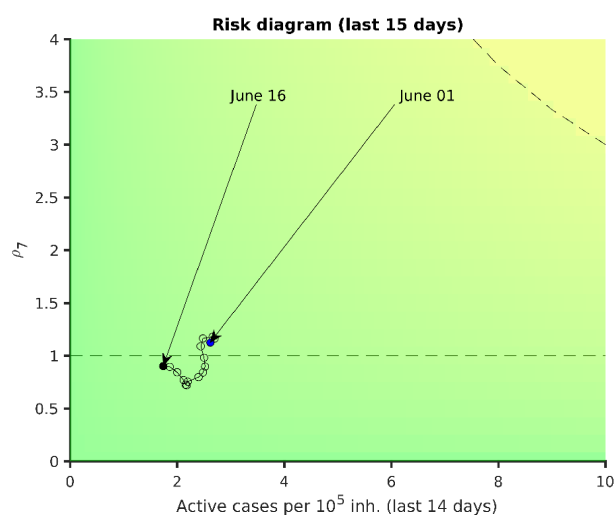
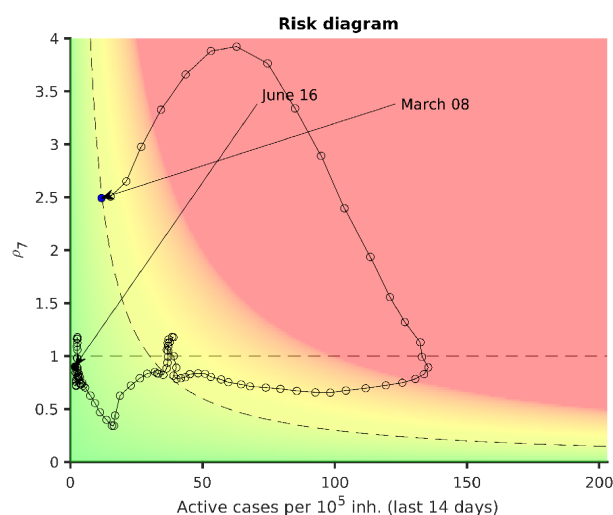
C Valenciana 16-06-2020. Population: 5.0M. Current cumulative incidence: 295/10⁵

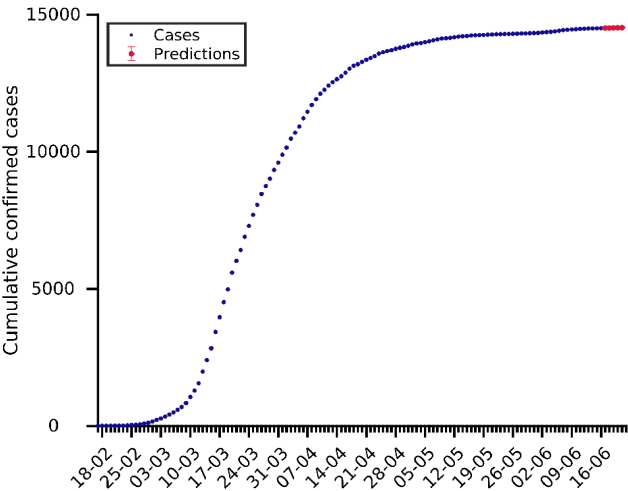


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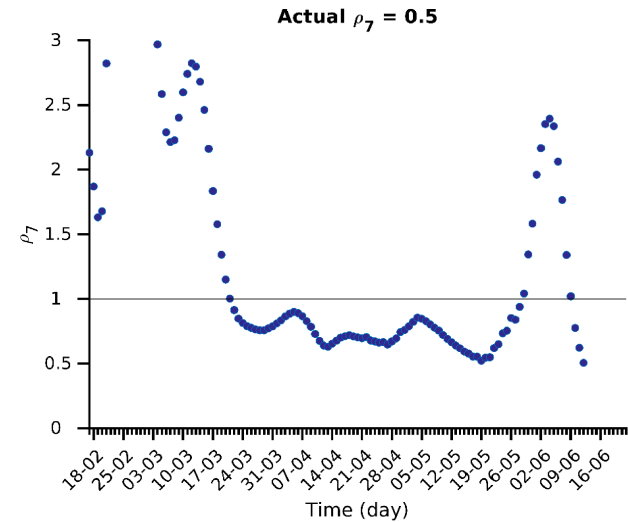
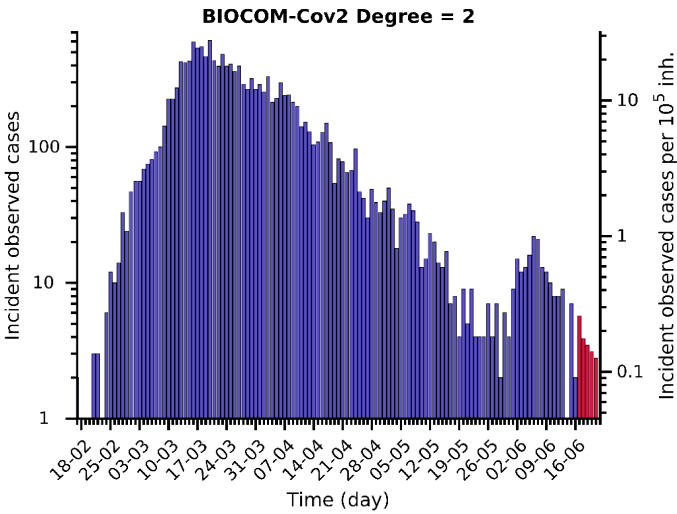
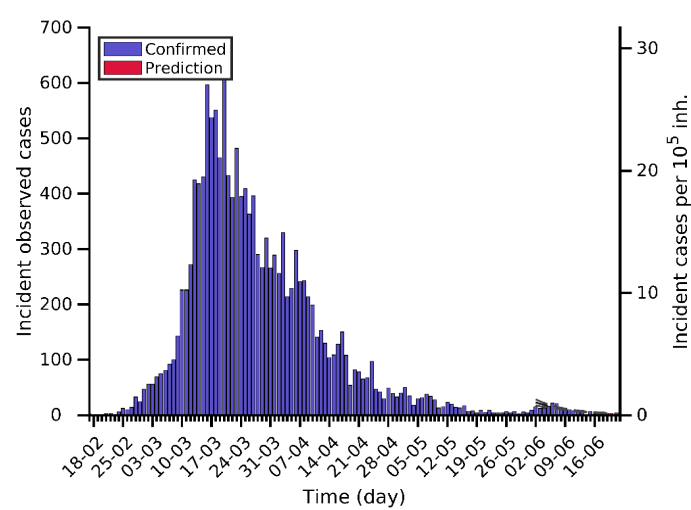


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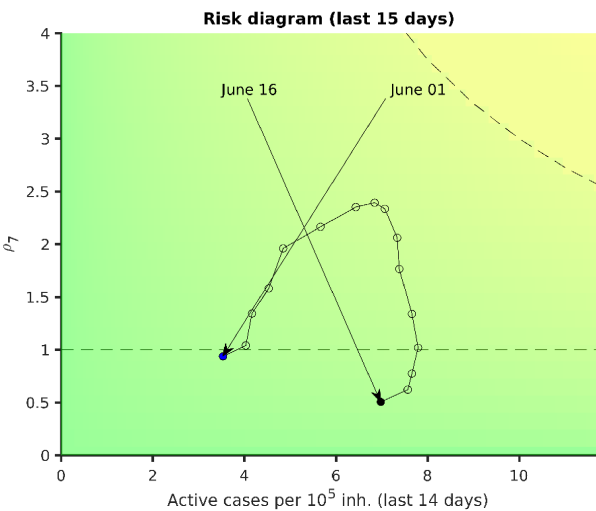
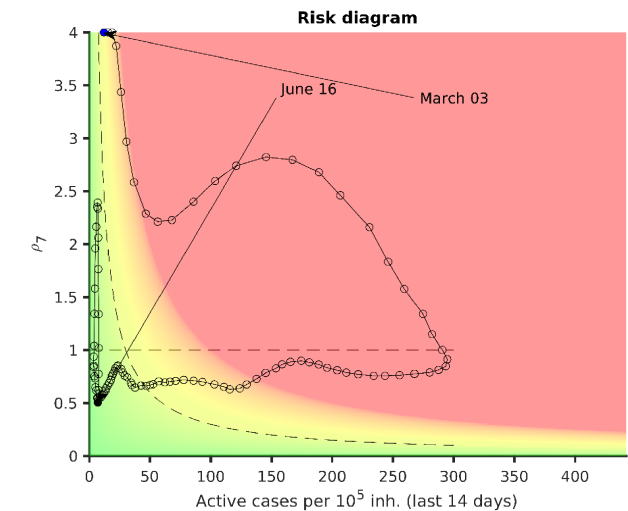




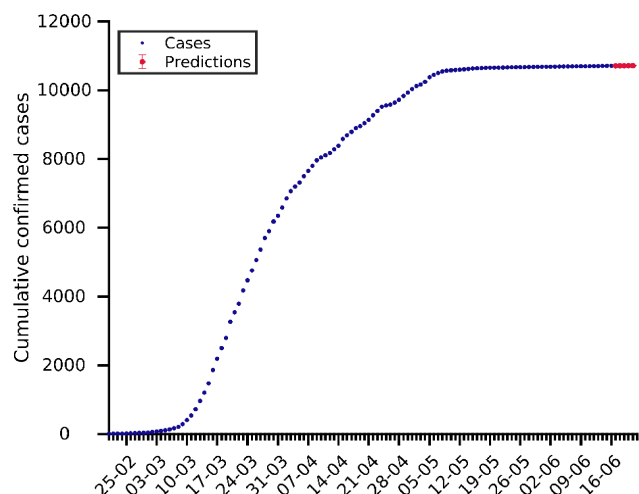
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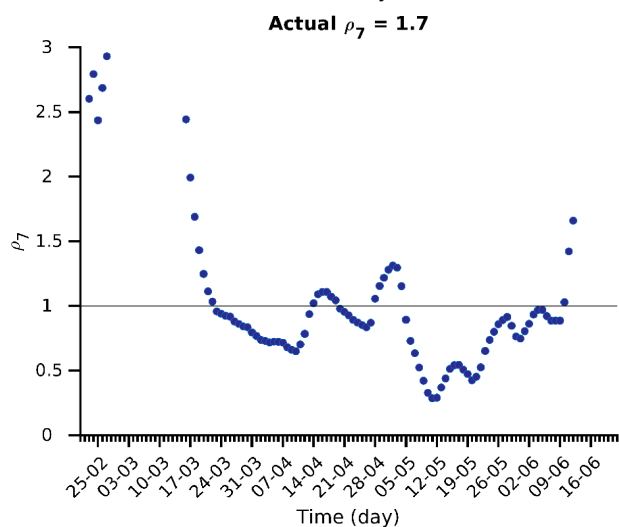
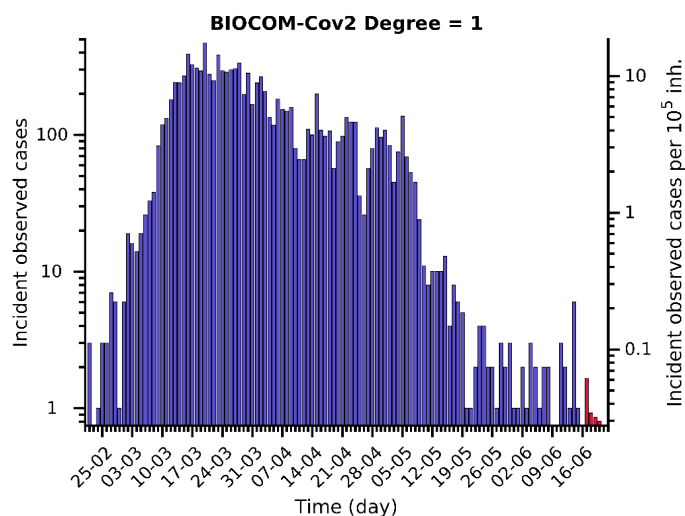
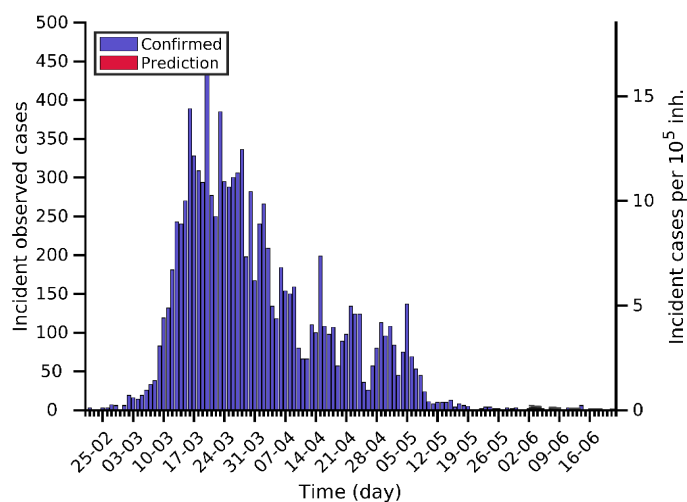
Deaths series currently under revision



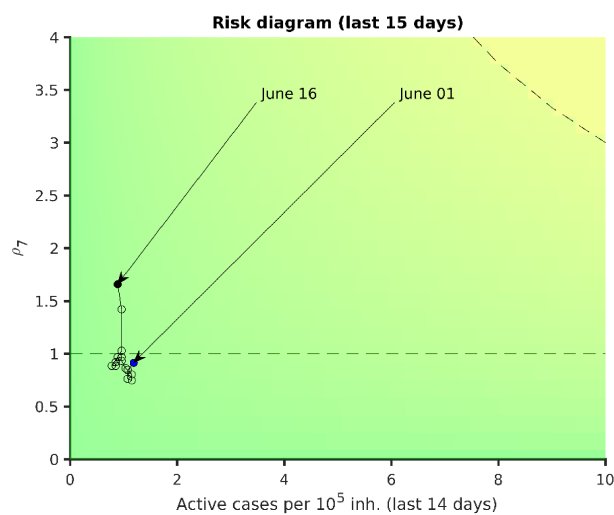
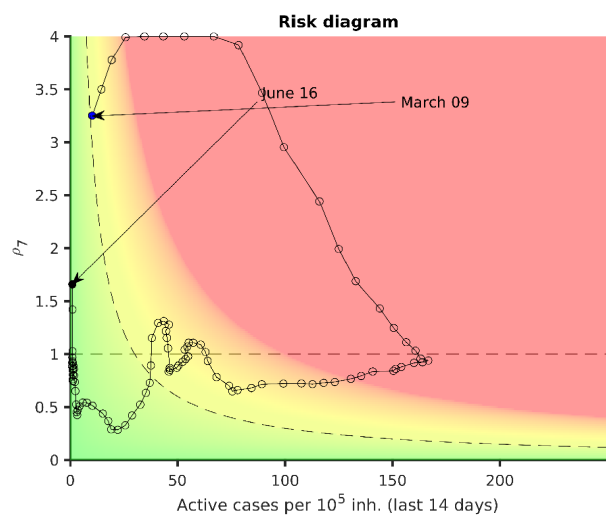
Galicia 16-06-2020. Population: 2.7M. Current cumulative incidence: 397/10⁵

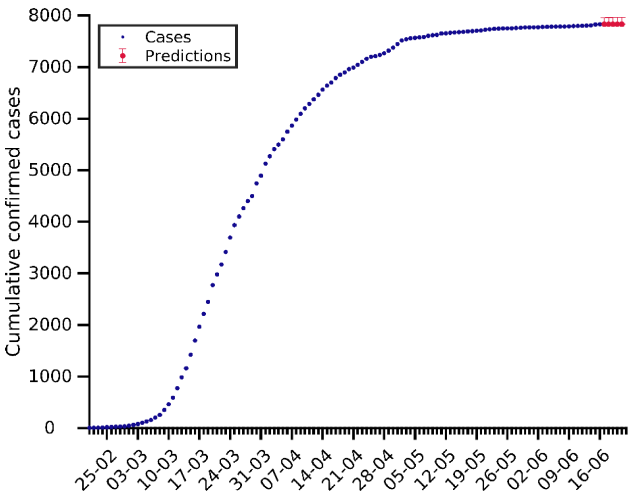


Deaths series currently under revision

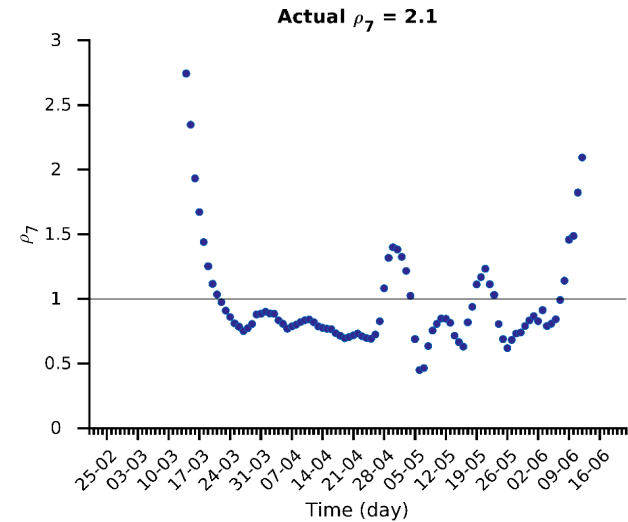
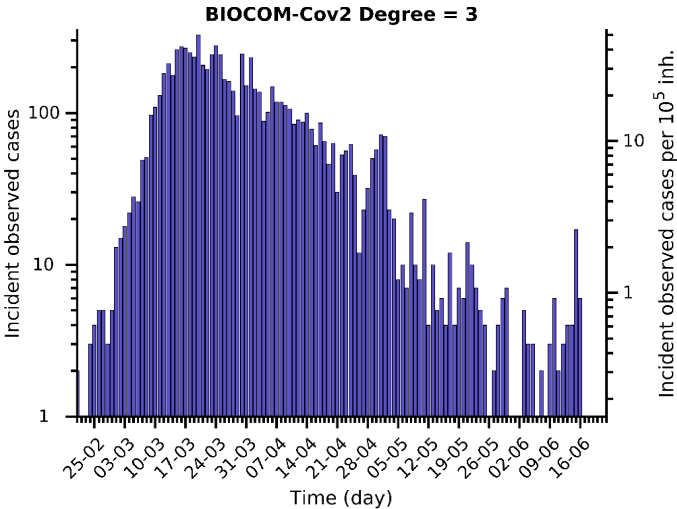
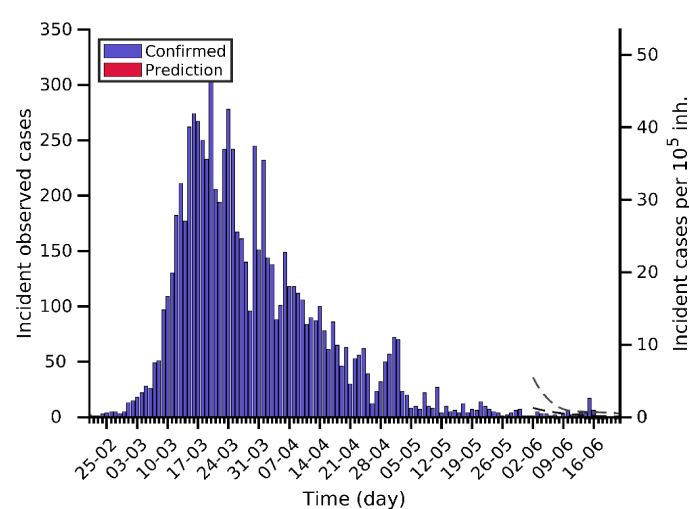


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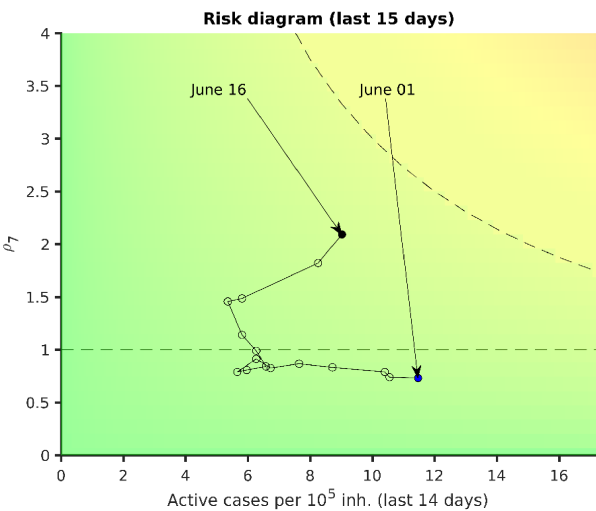
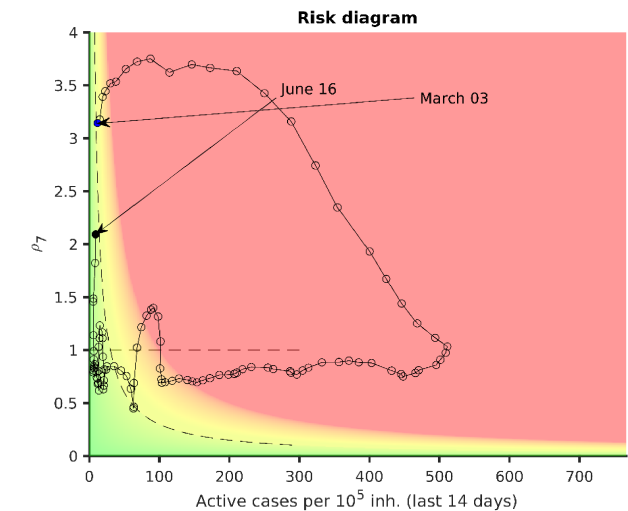


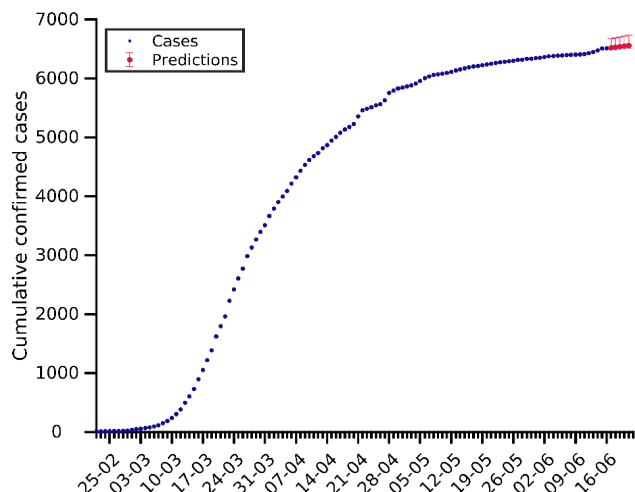


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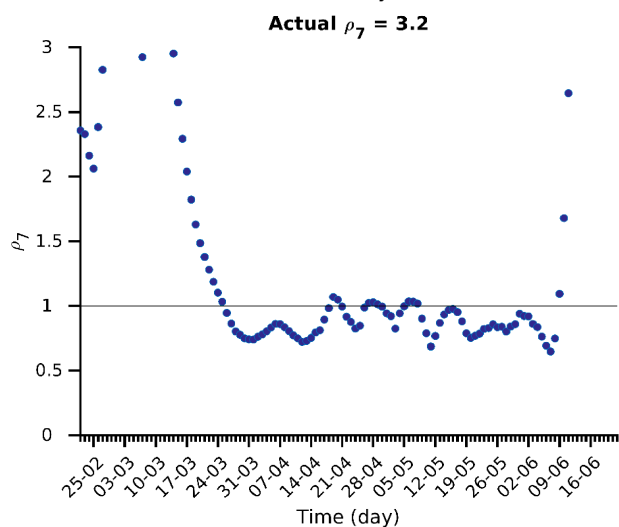
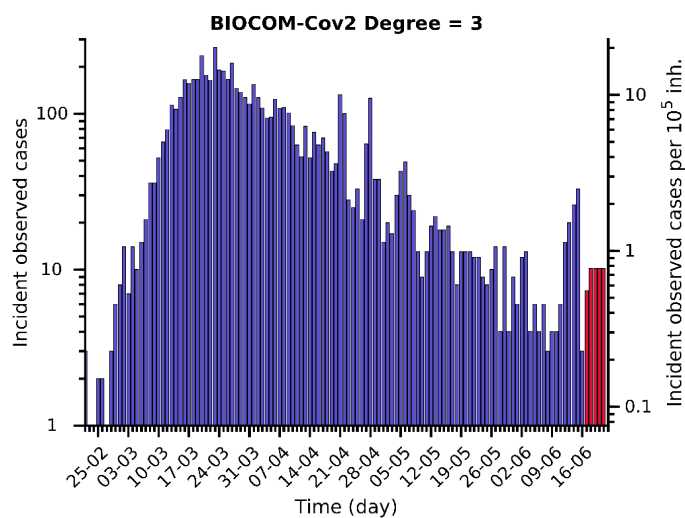
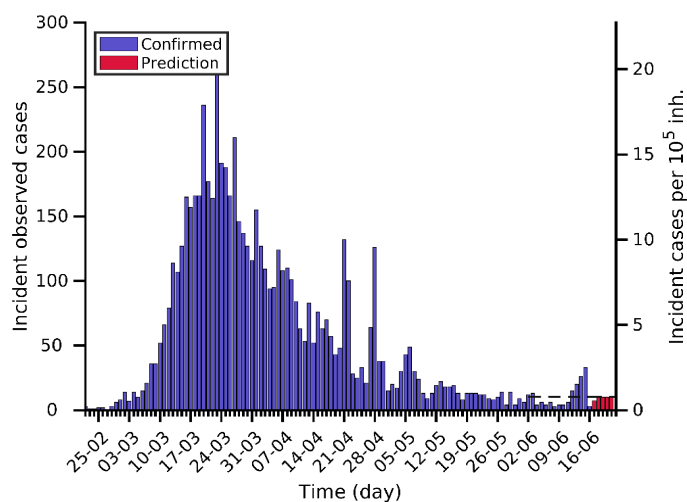


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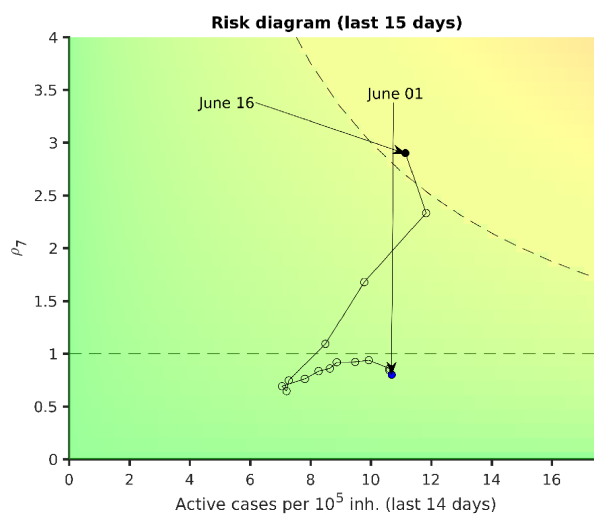
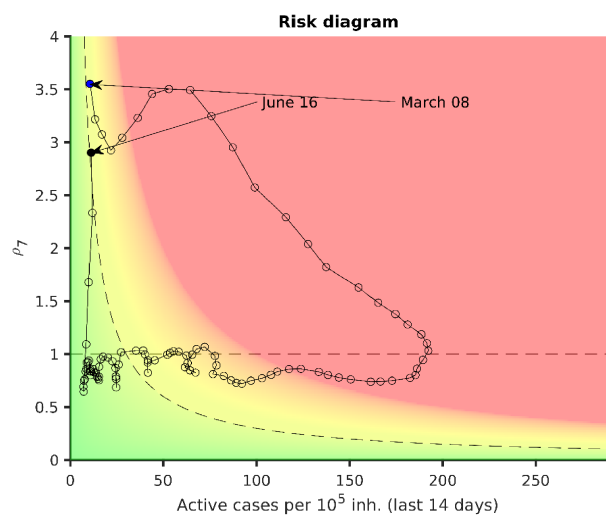


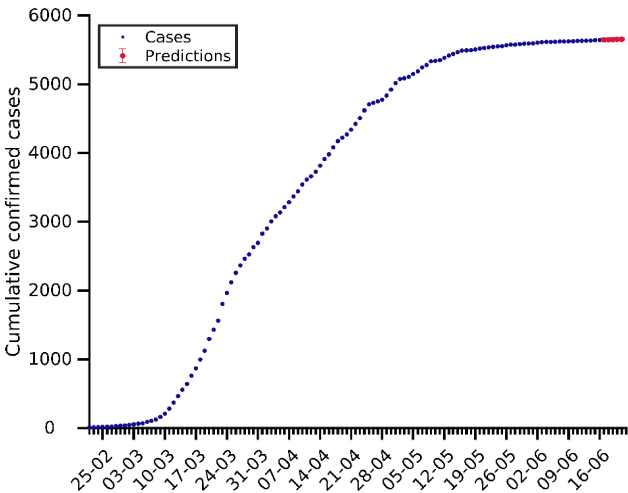


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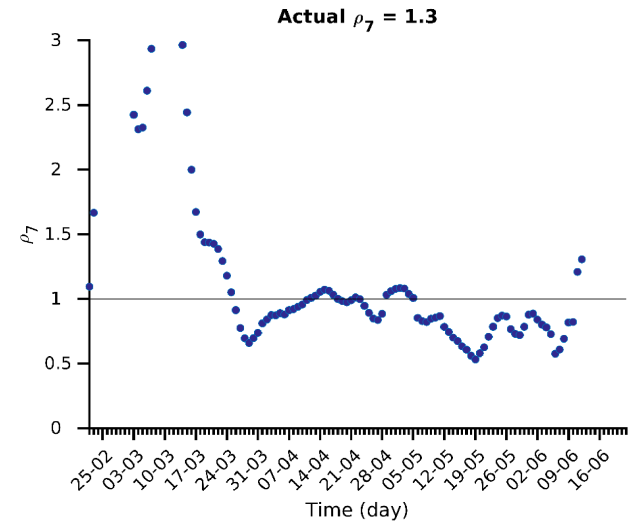
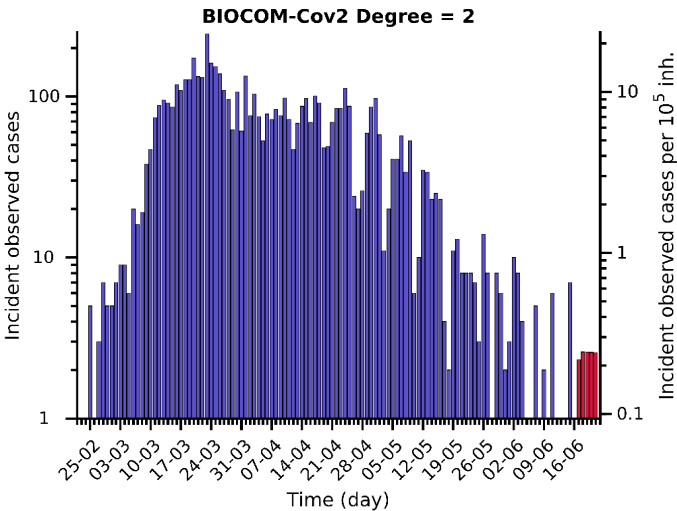
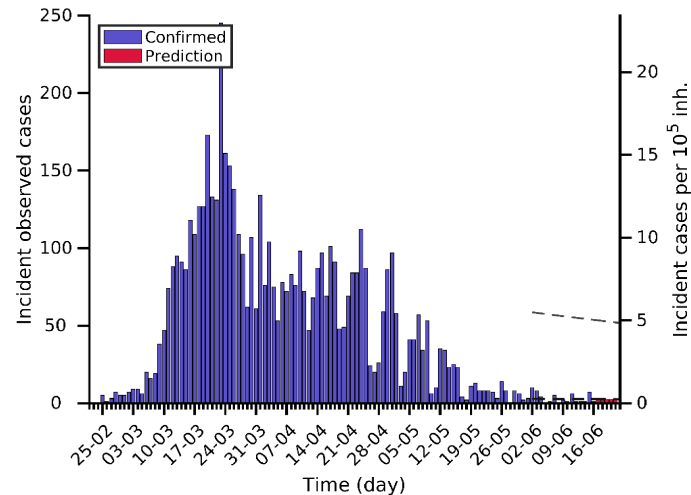


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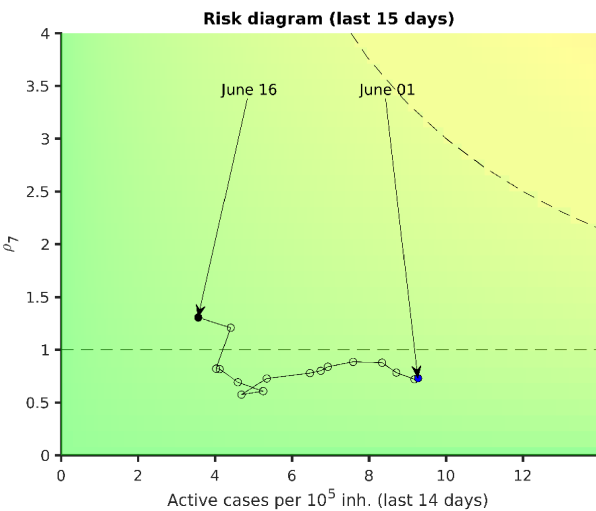
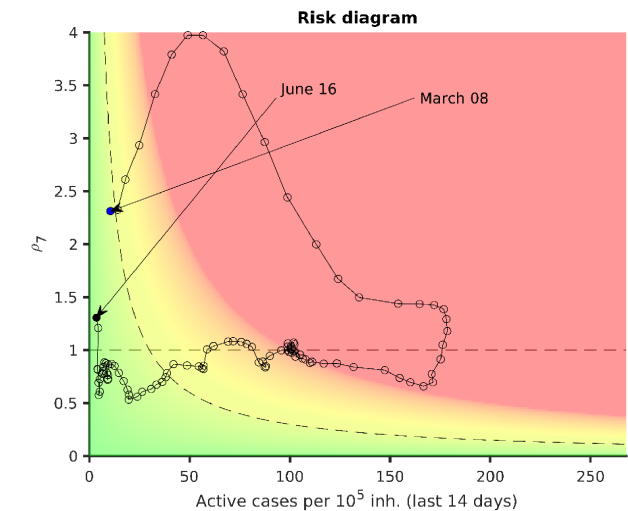


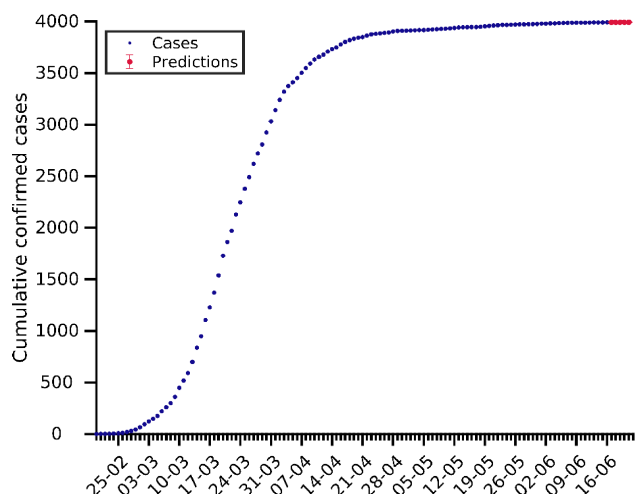


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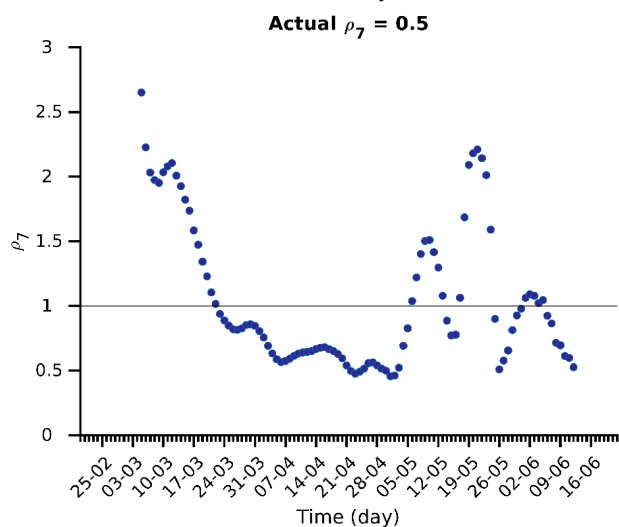
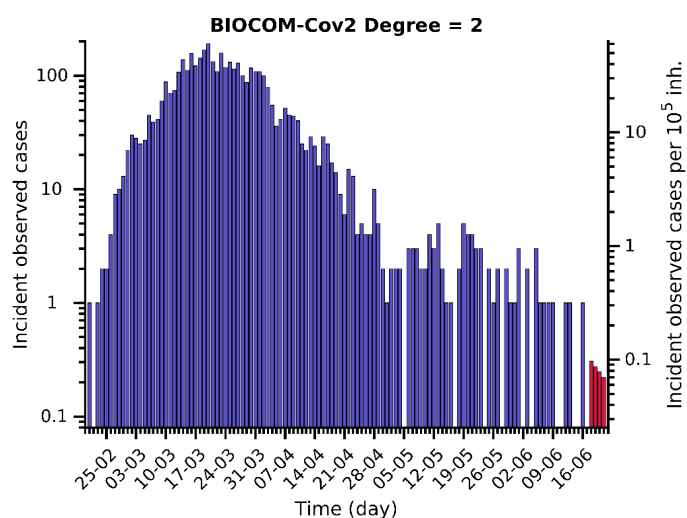
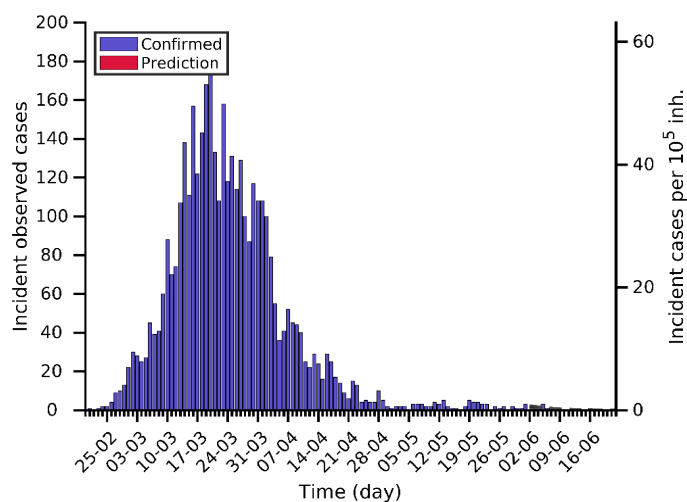


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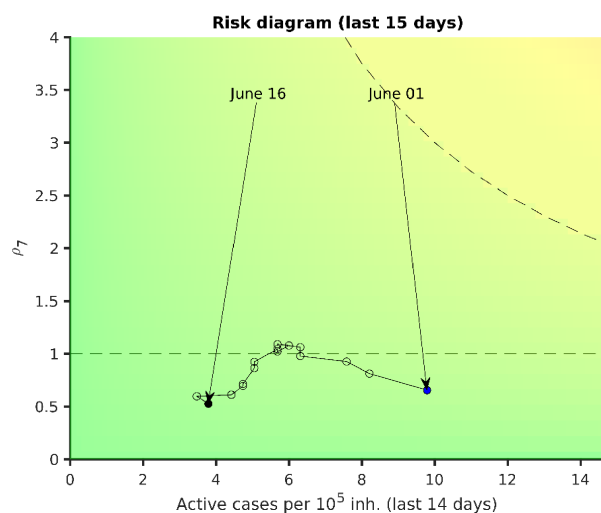
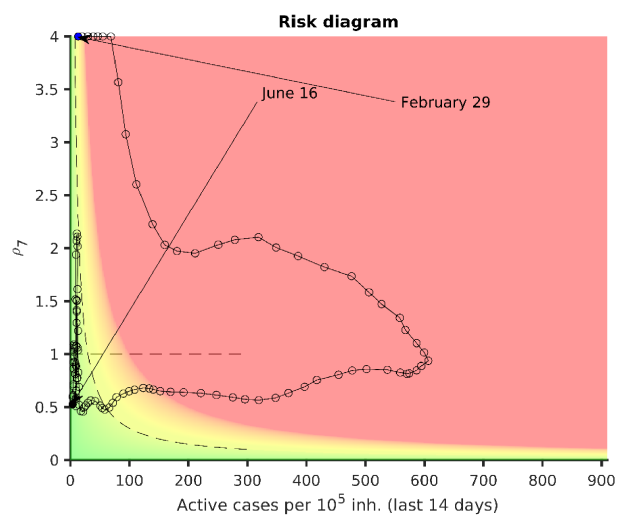


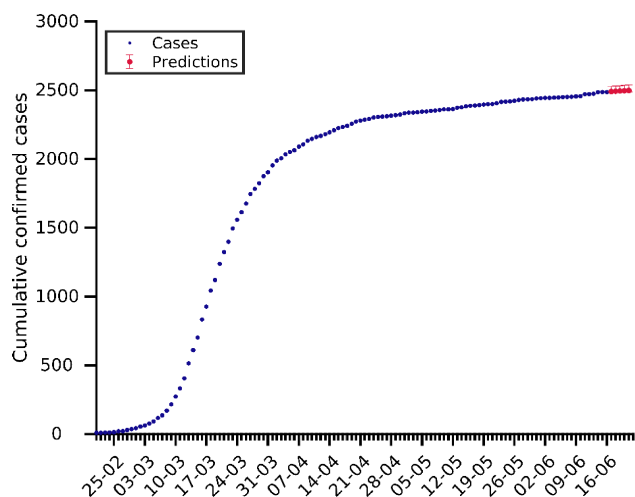


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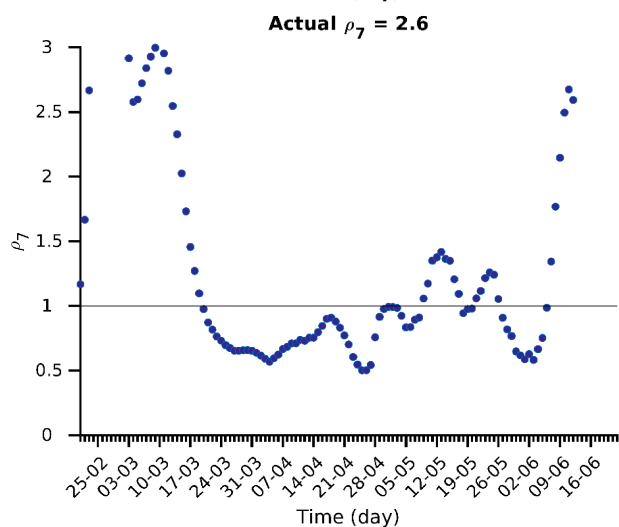
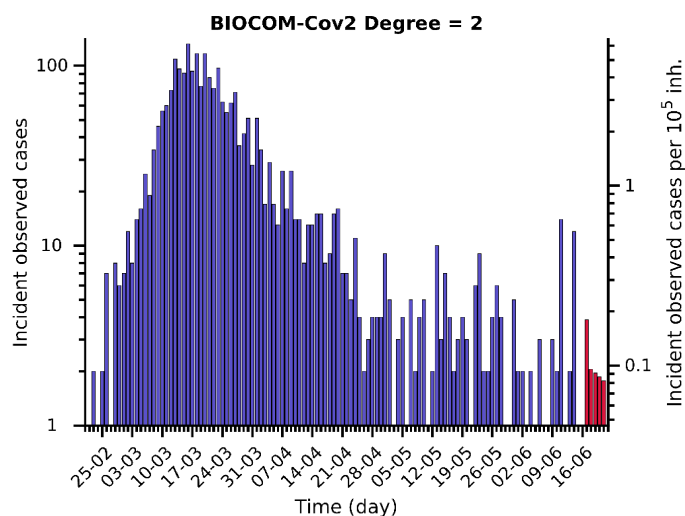
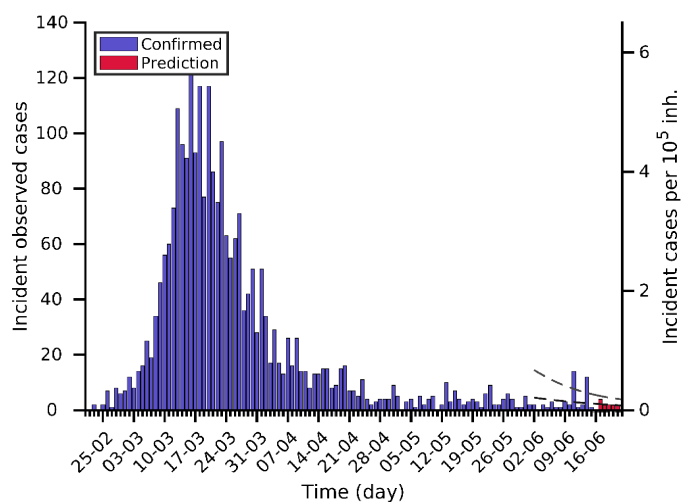


Deaths series currently under revision

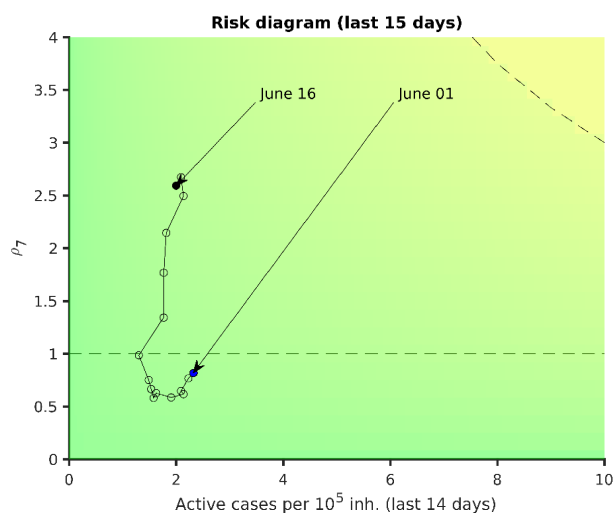
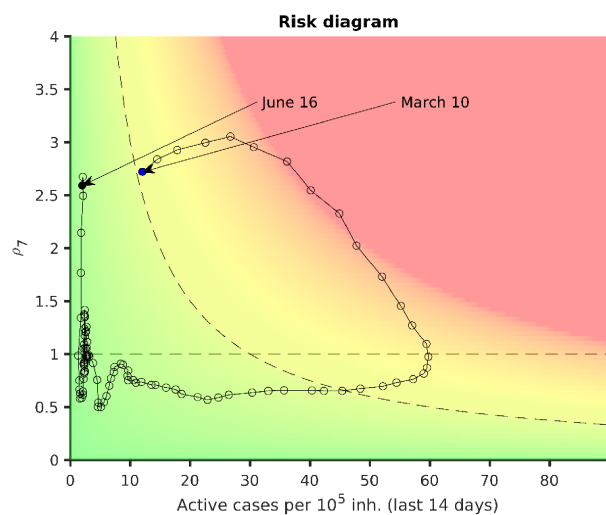


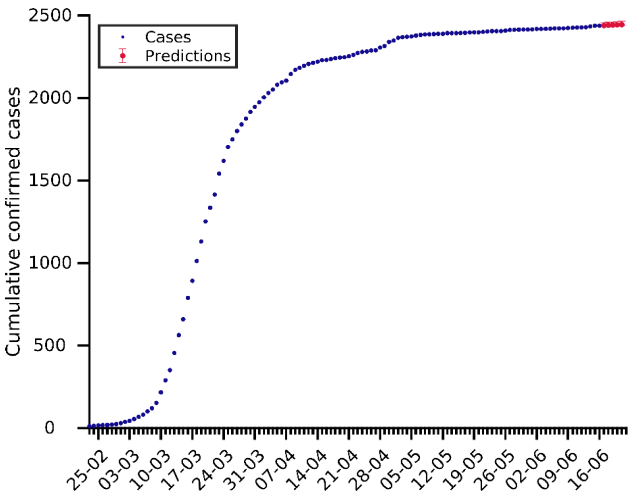


Deaths series currently under revision

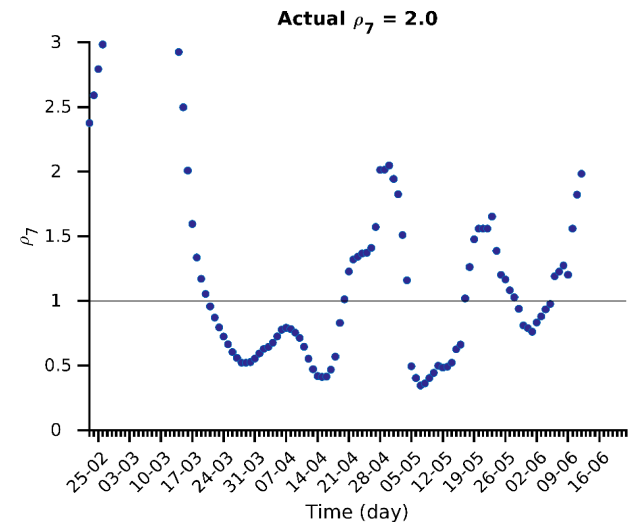
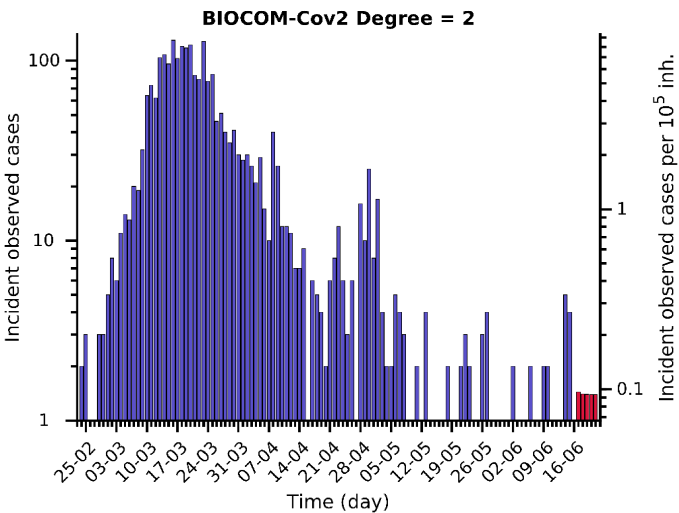
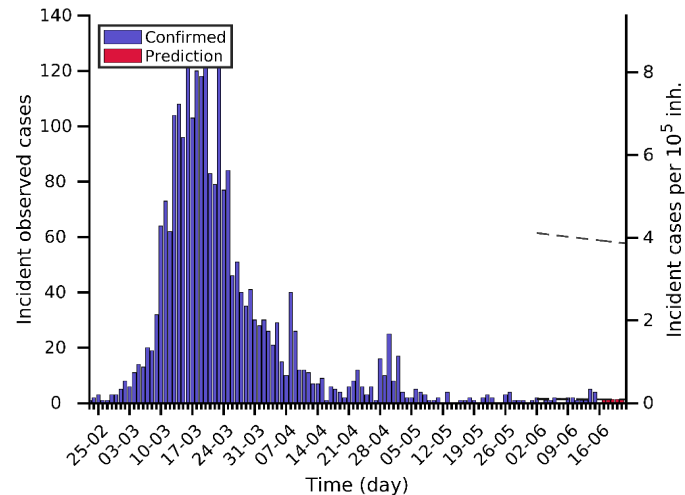


Deaths series currently under revision

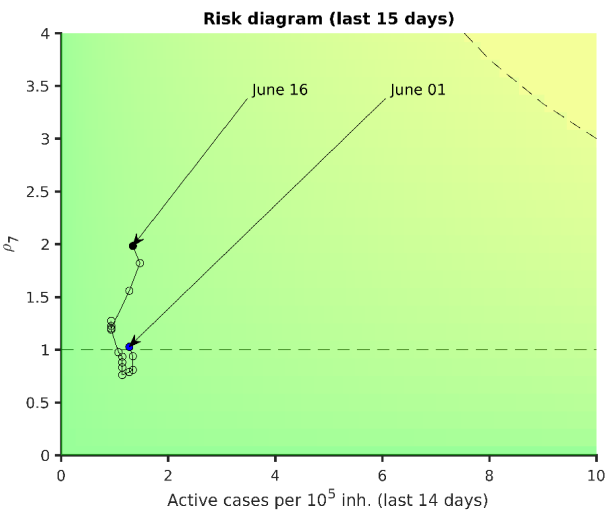
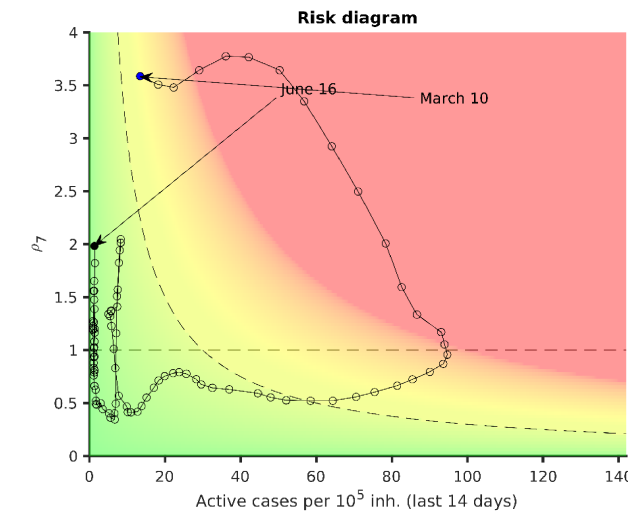


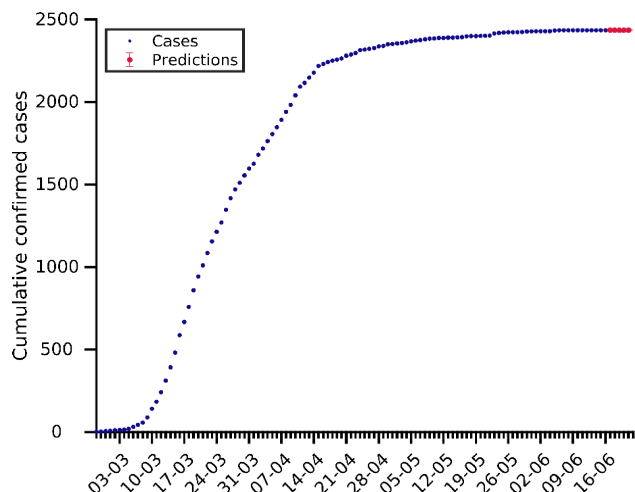


Deaths series currently under revision

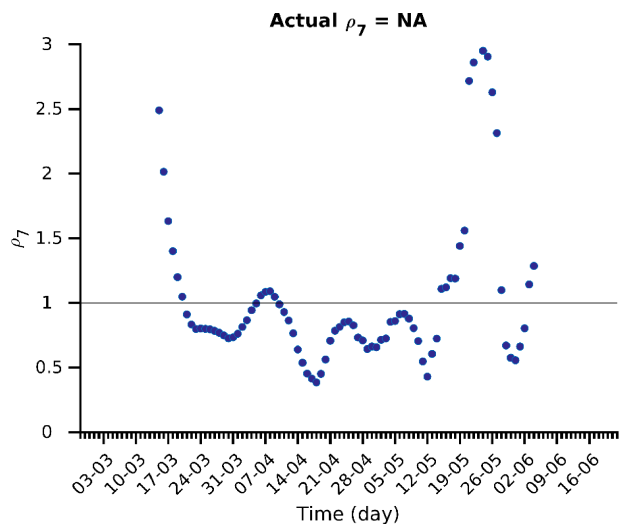
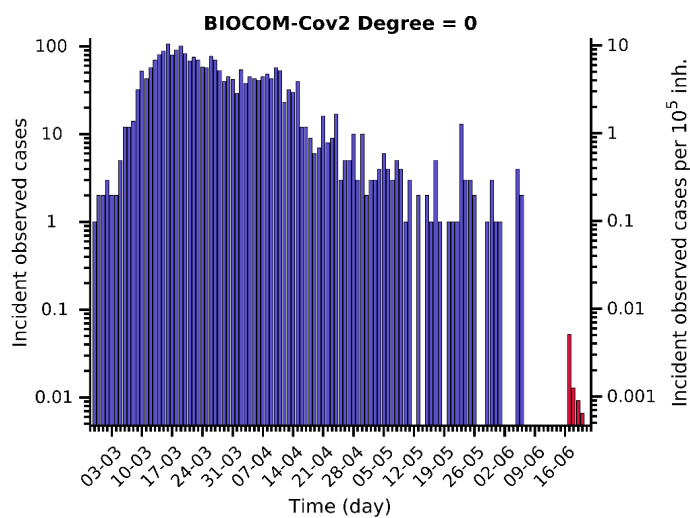
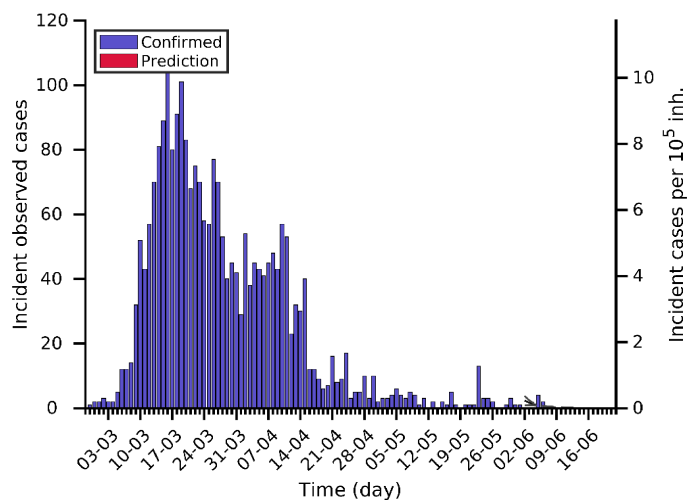


Deaths series currently under revision

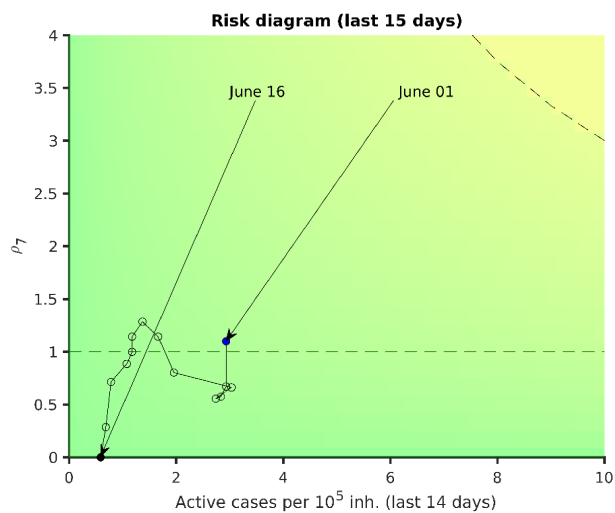
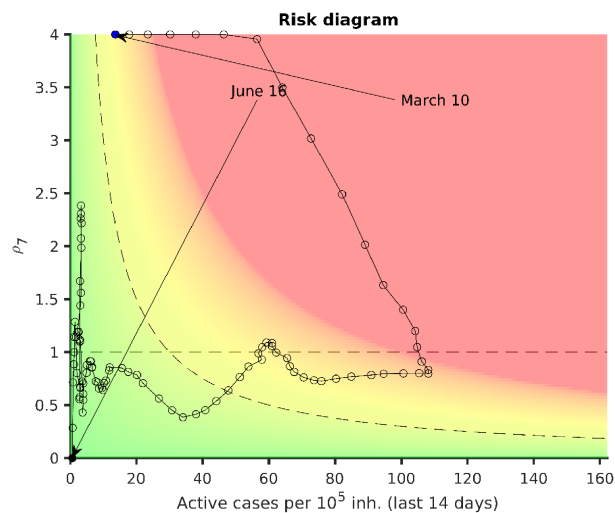




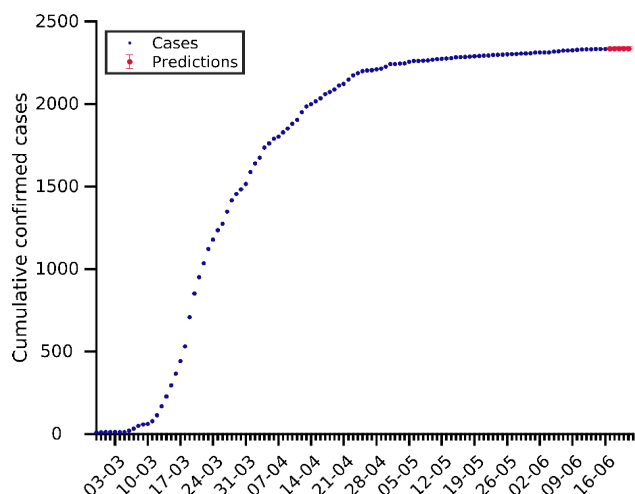
Deaths series currently under revision



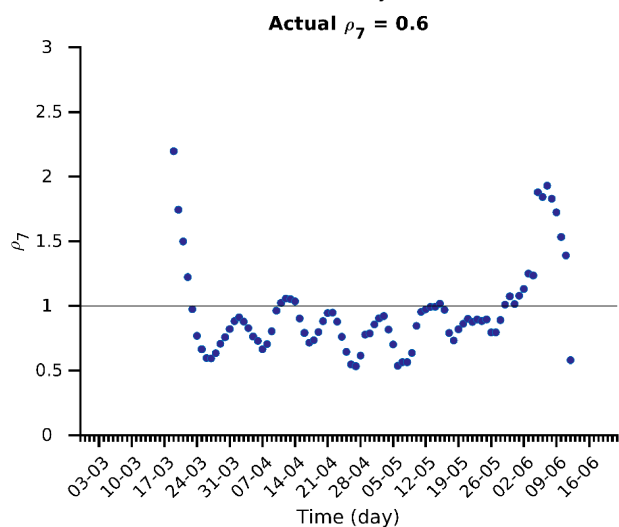
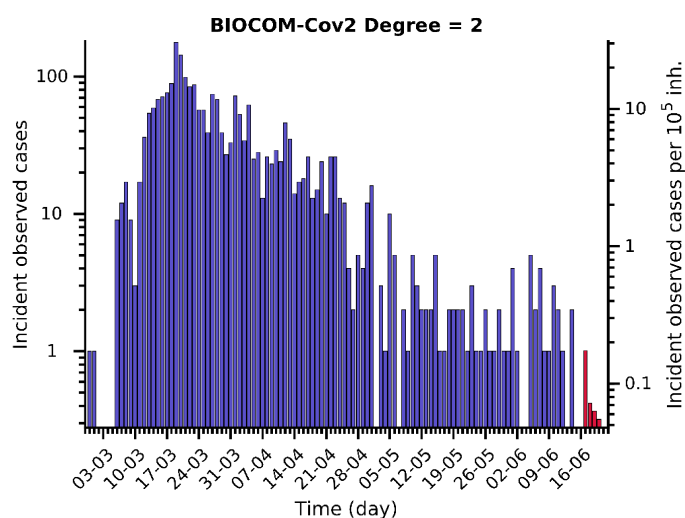
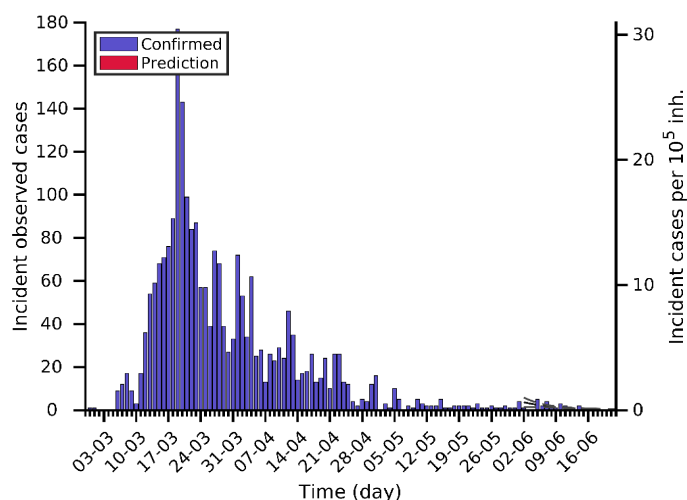
Deaths series currently under revision



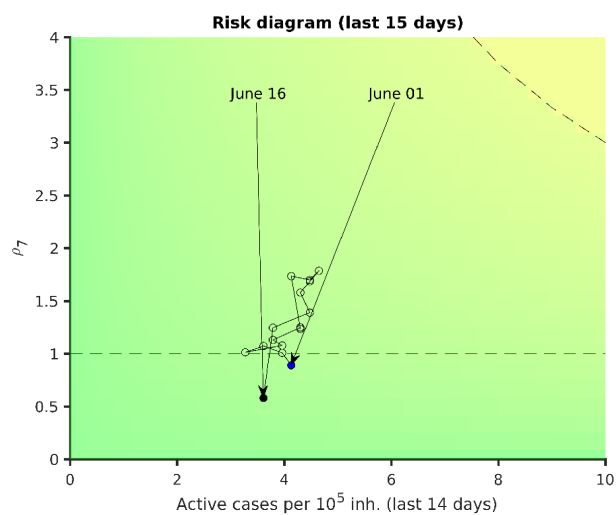
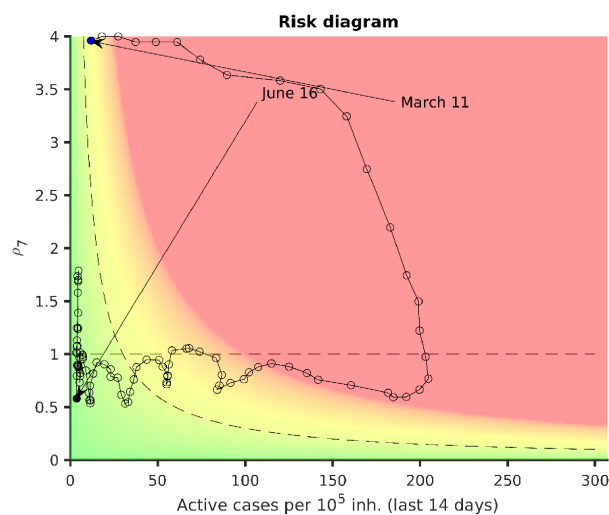
Cantabria 16-06-2020. Population: 0.6M. Current cumulative incidence: 401/10⁵



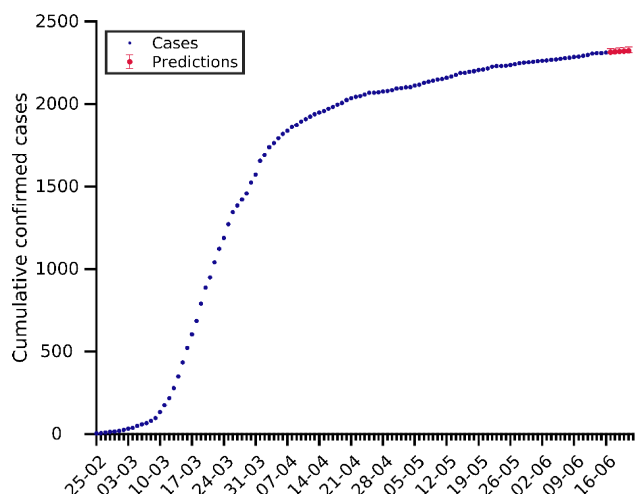
Deaths series currently under revision



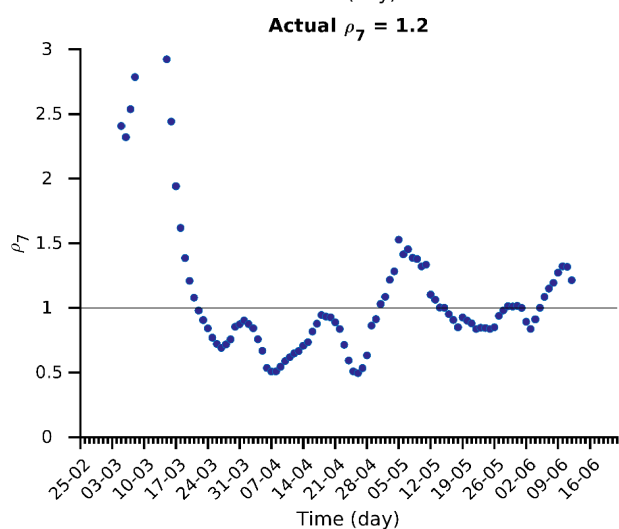
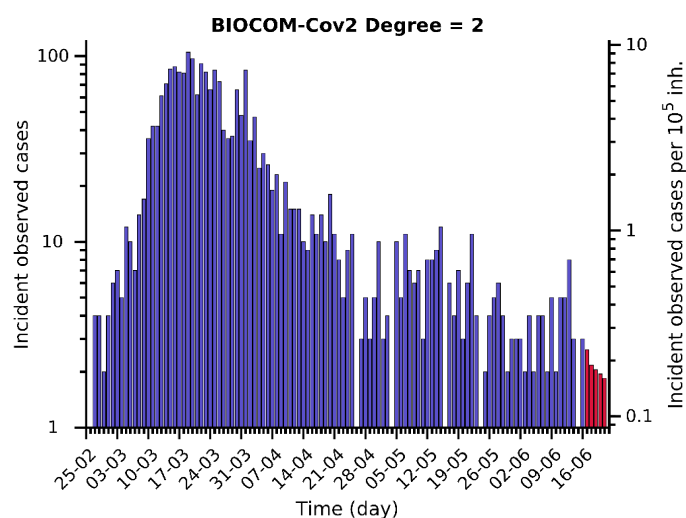
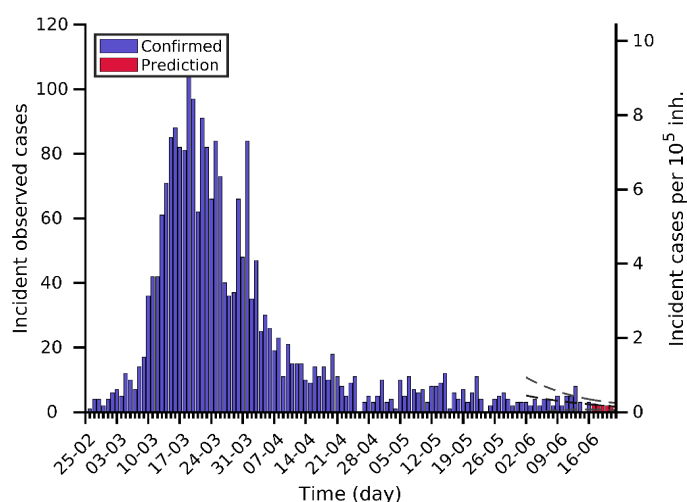
Deaths series currently under revision



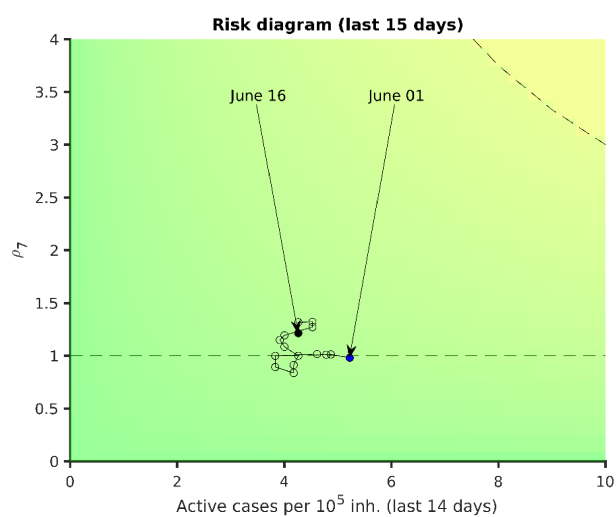
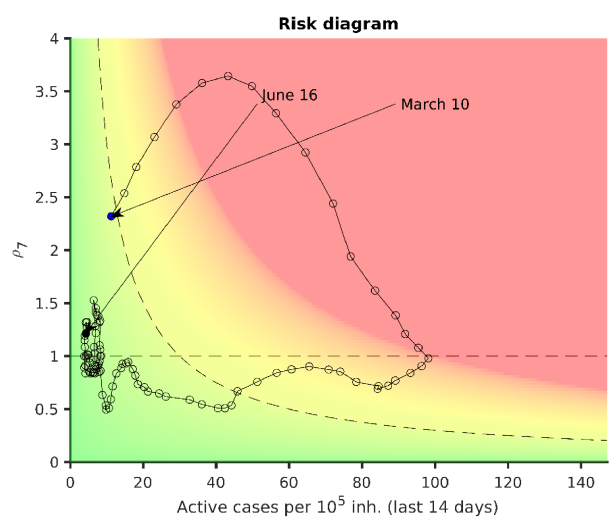
Baleares 16-06-2020. Population: 1.1M. Current cumulative incidence: 201/10⁵



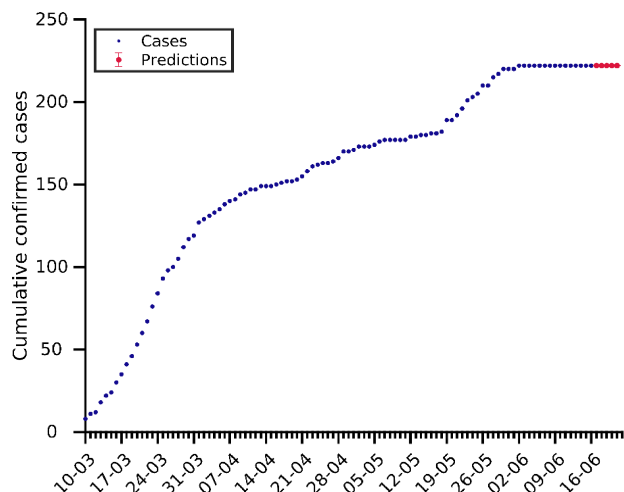
Deaths series currently under revision



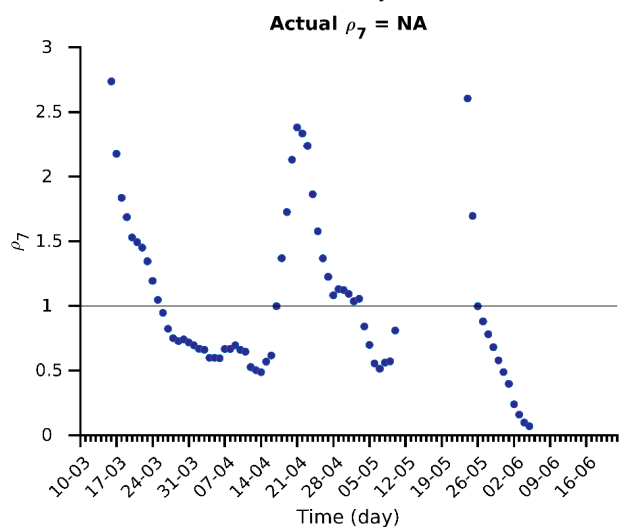
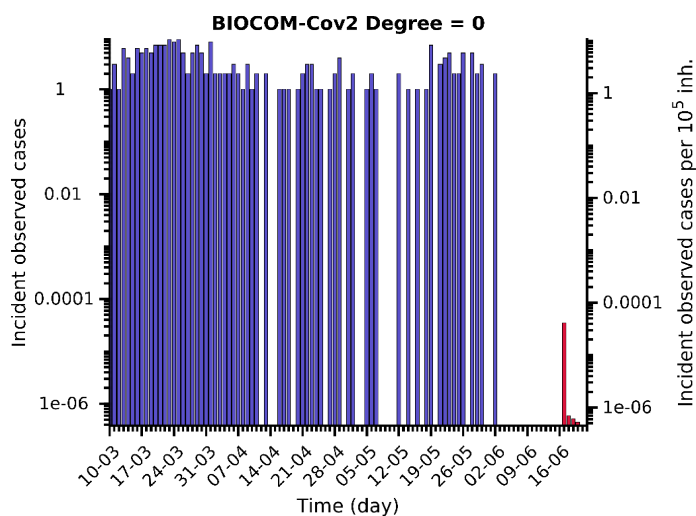
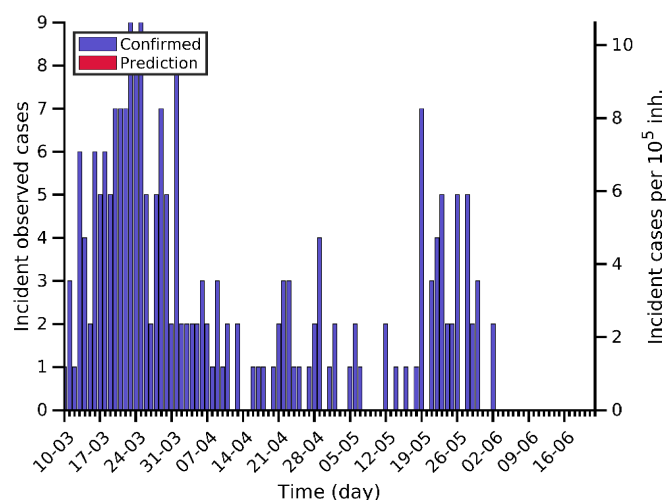
Deaths series currently under revision



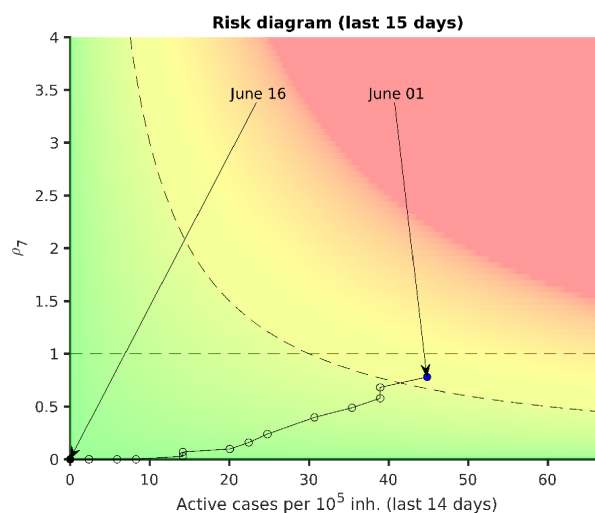
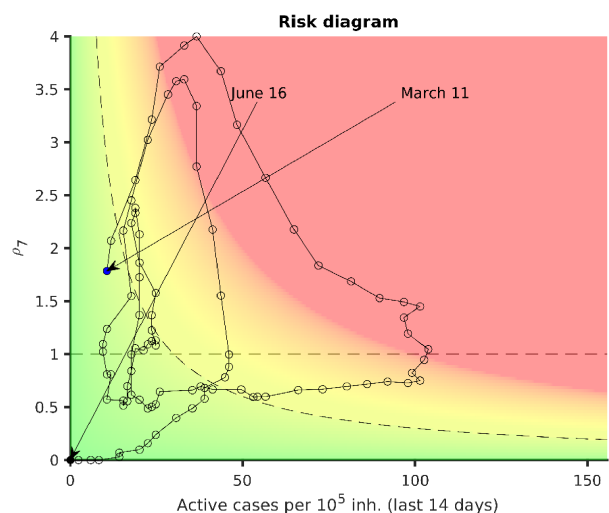
Ceuta 16-06-2020. Population: 0.1M. Current cumulative incidence: 262/10⁵



Deaths series currently under revision



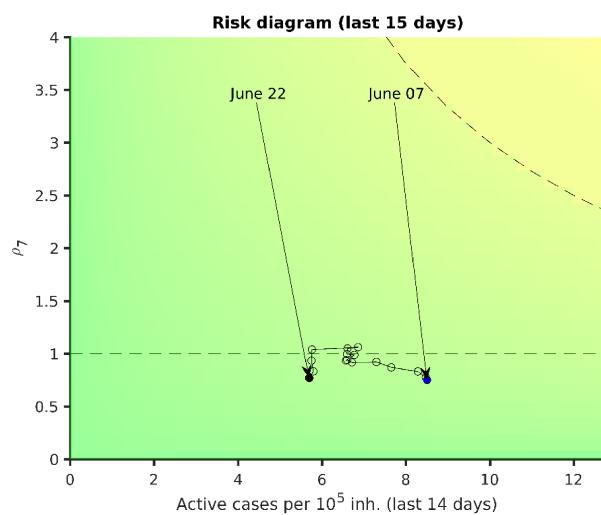
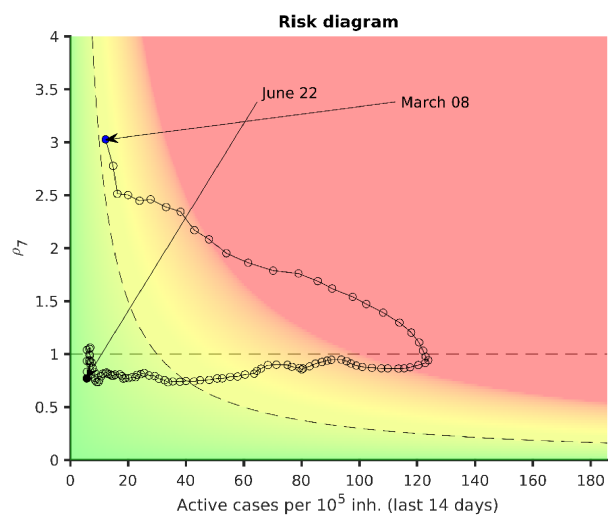
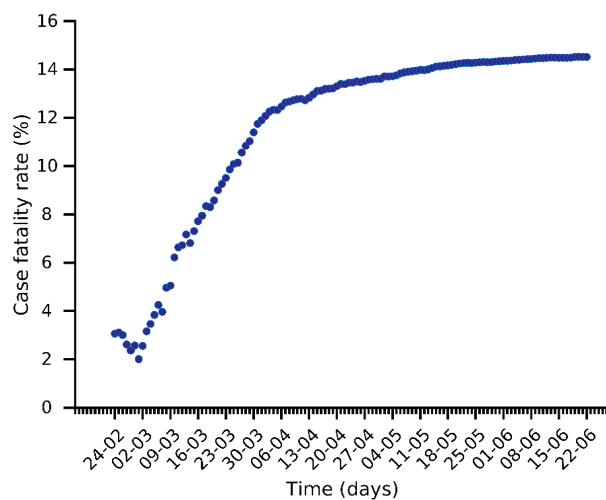
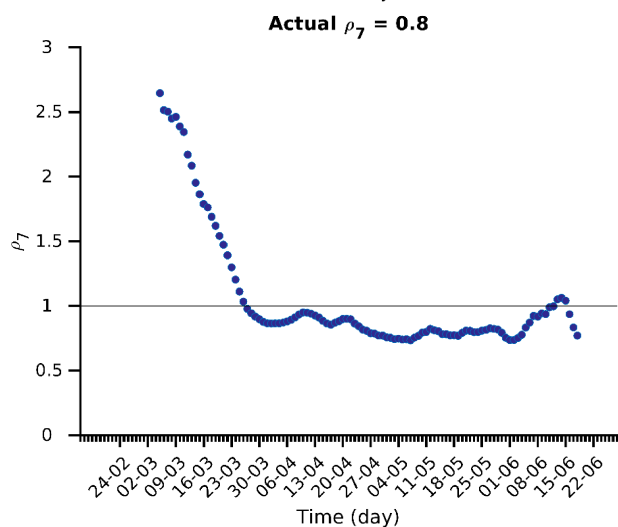
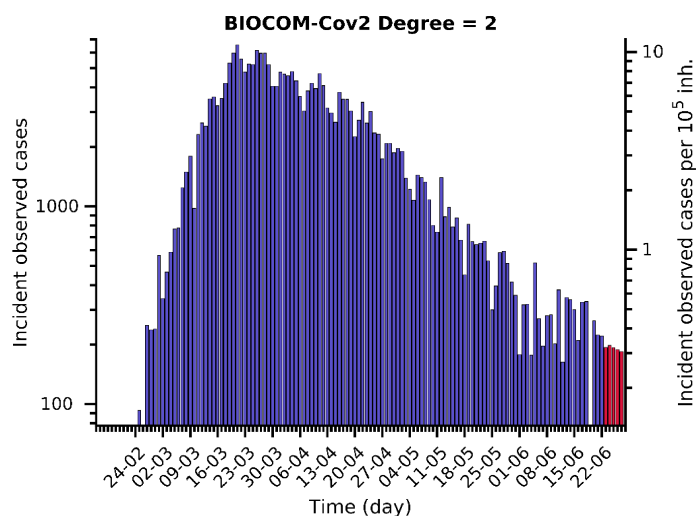
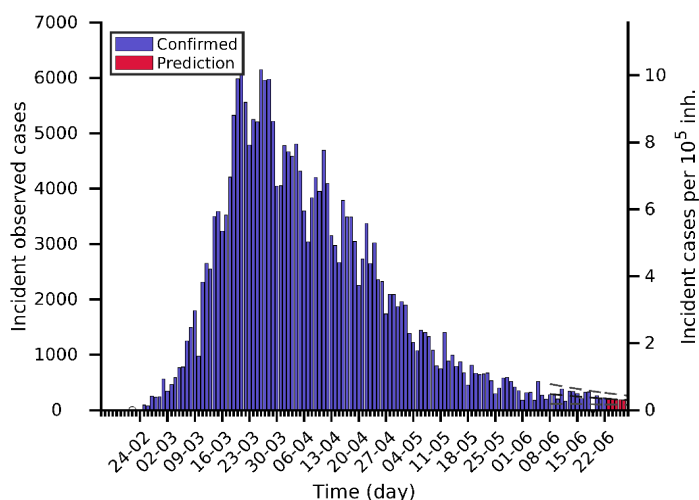
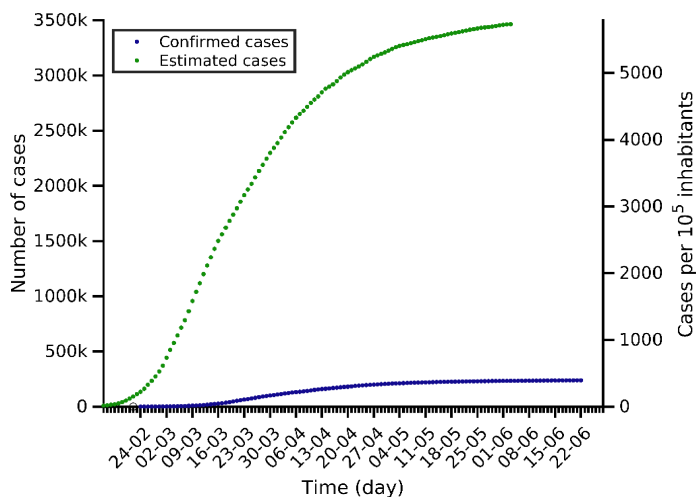
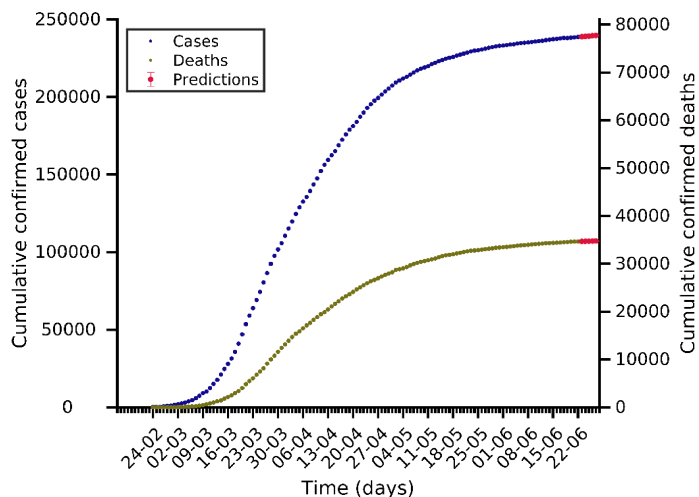
Deaths series currently under revision



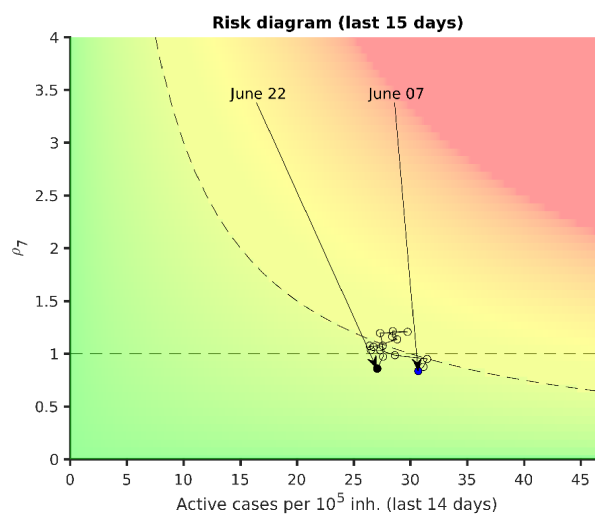
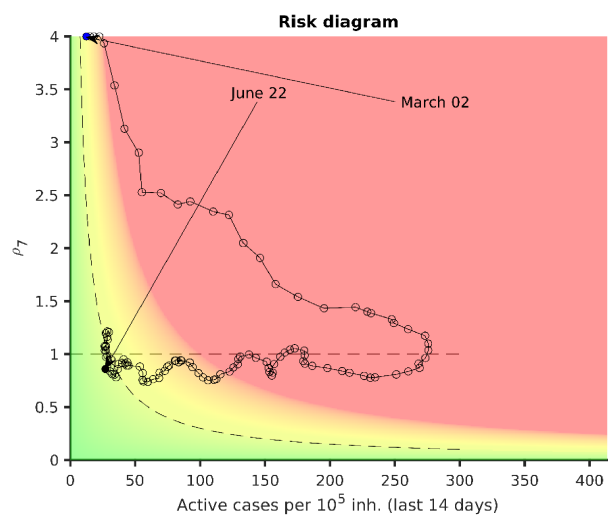
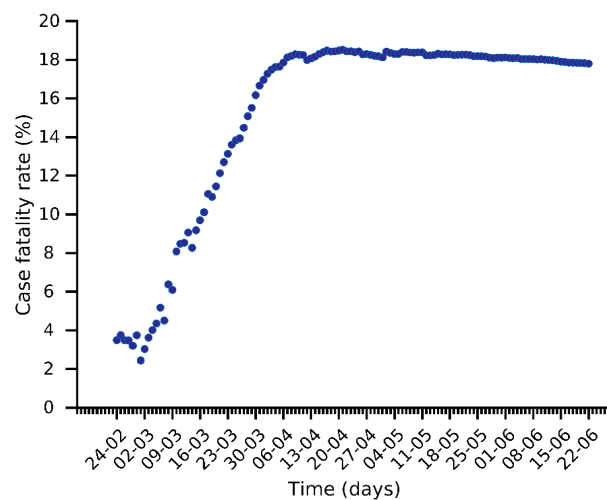
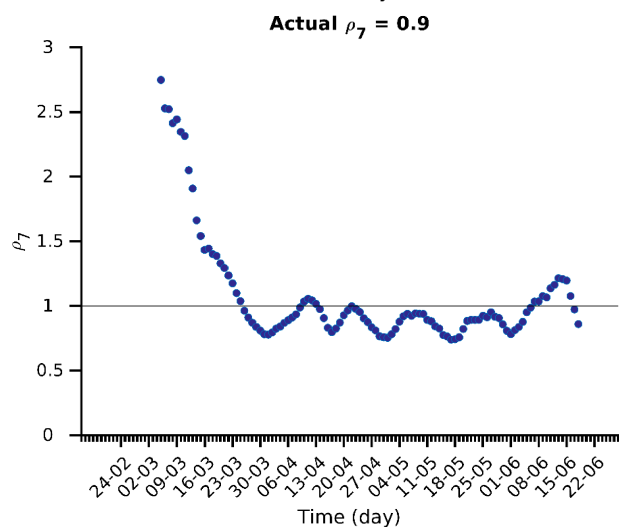
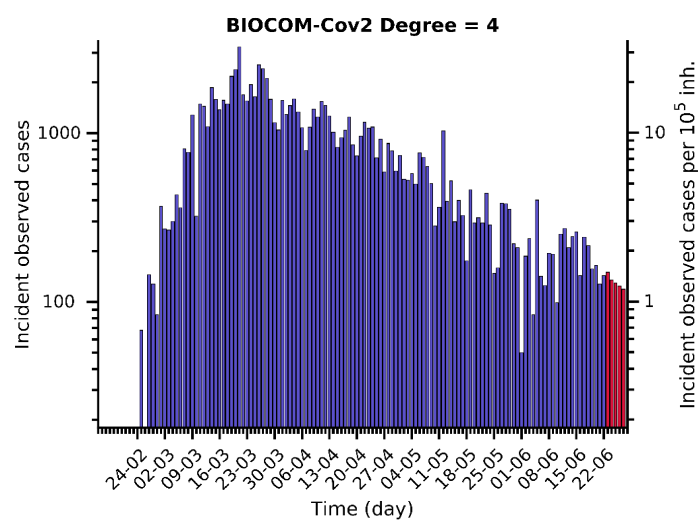
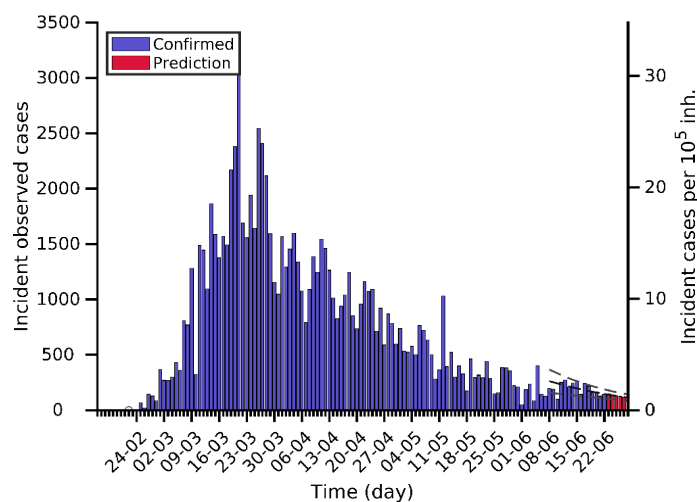
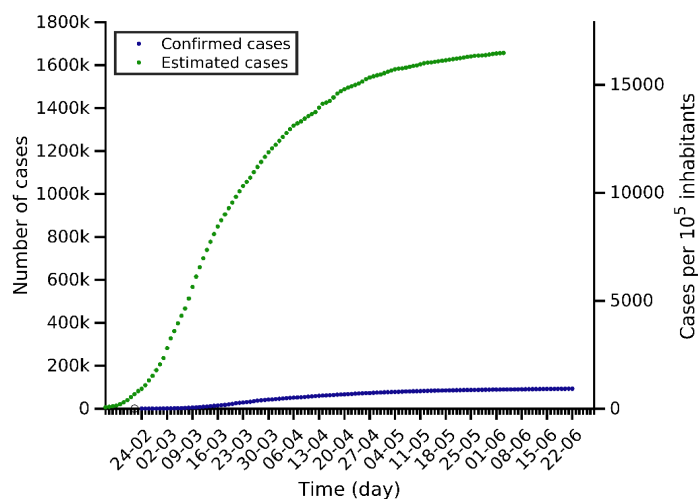
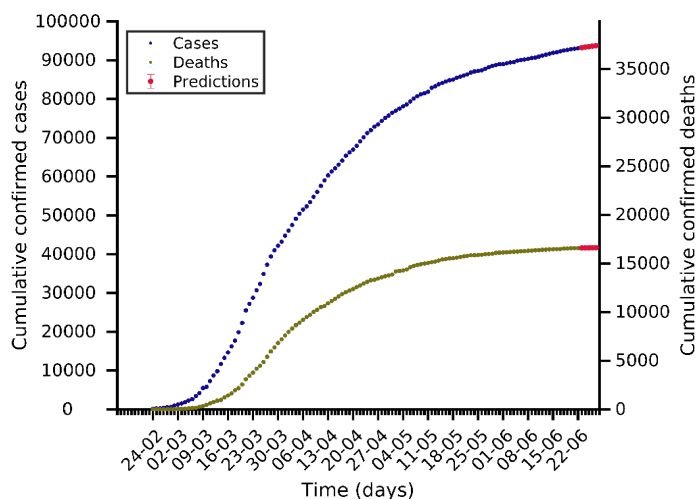
(4) Analysis and prediction of COVID-19 for Italy and its regions

Data obtained from: <https://github.com/pcm-dpc/COVID-19/tree/master/dati-andamento-nazionale>

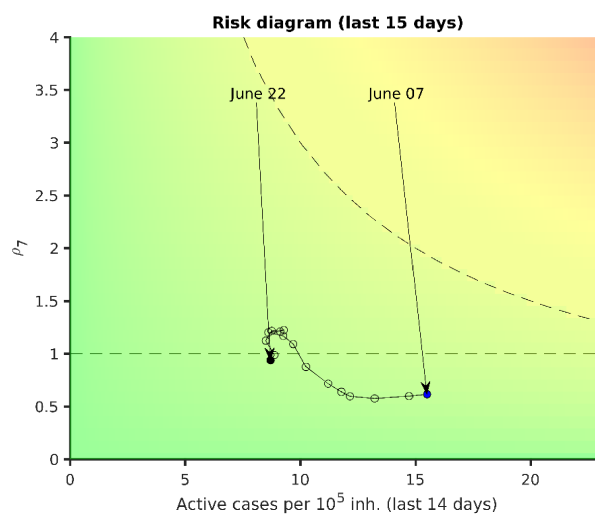
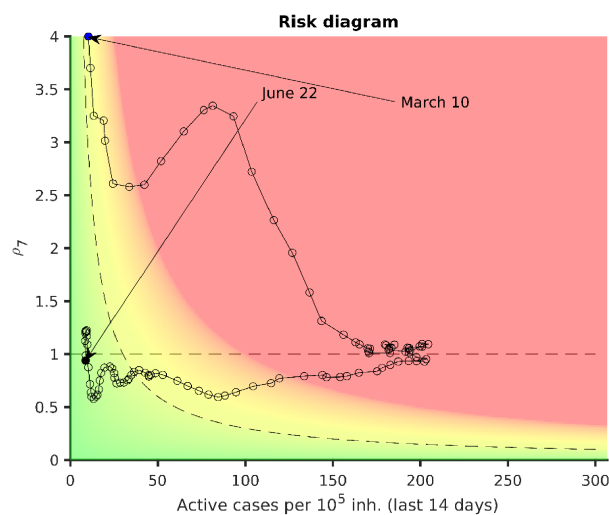
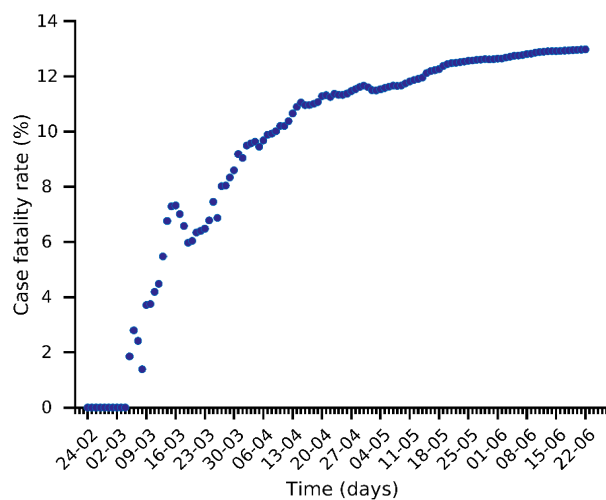
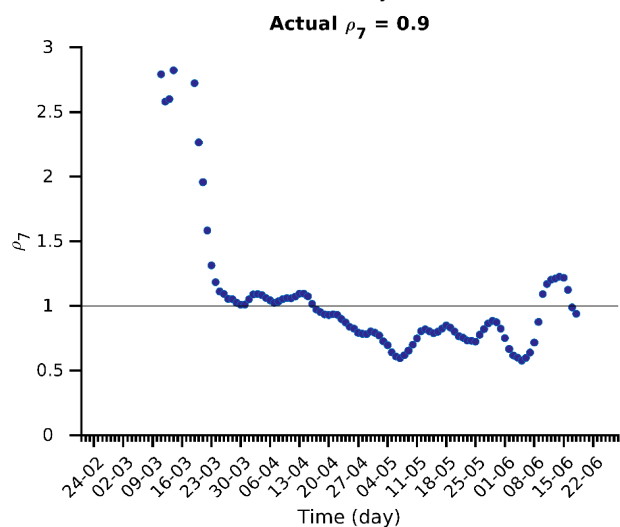
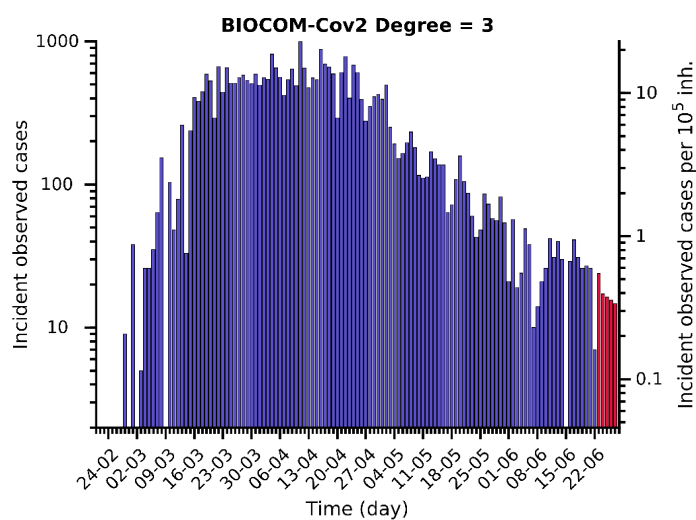
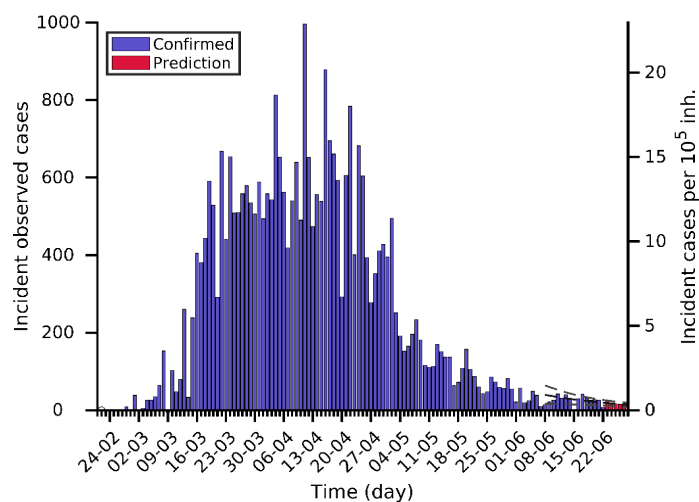
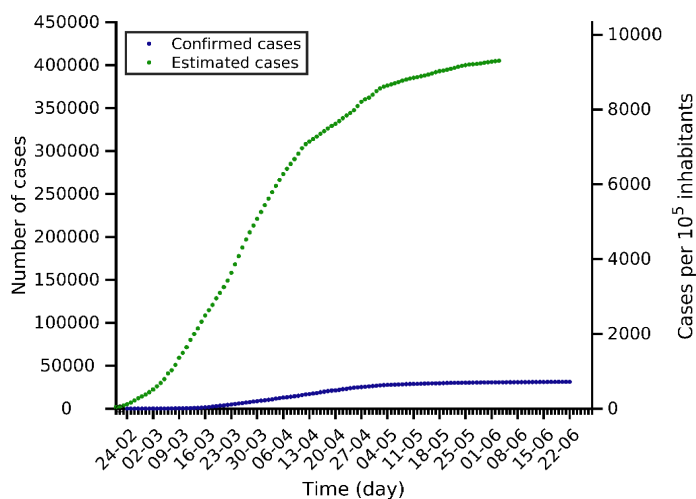
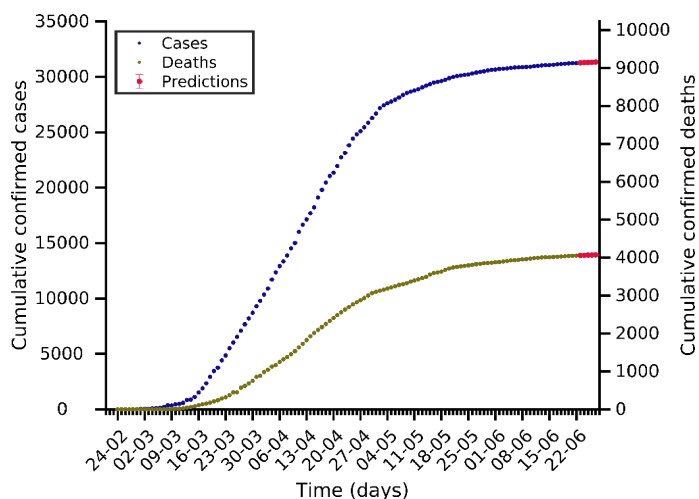
Italy 22-06-2020. Population: 60.5M. Current cumulative incidence: 395/10⁵



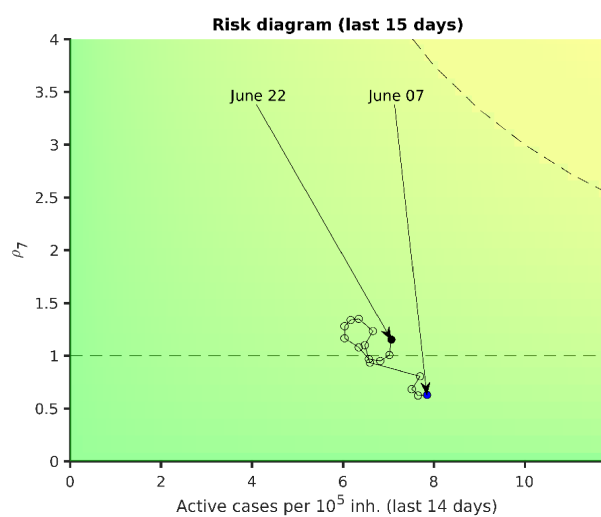
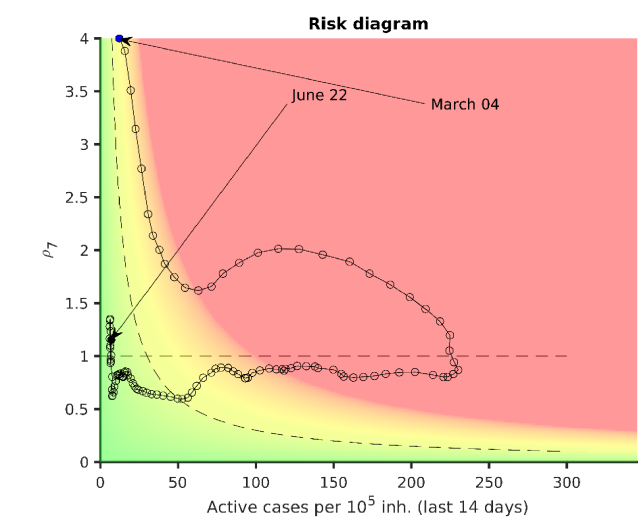
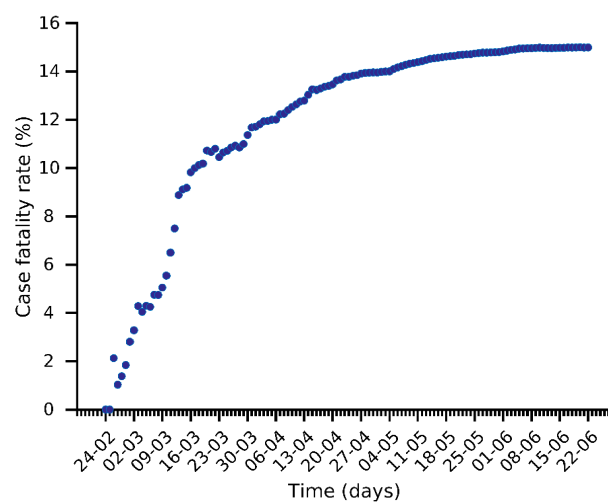
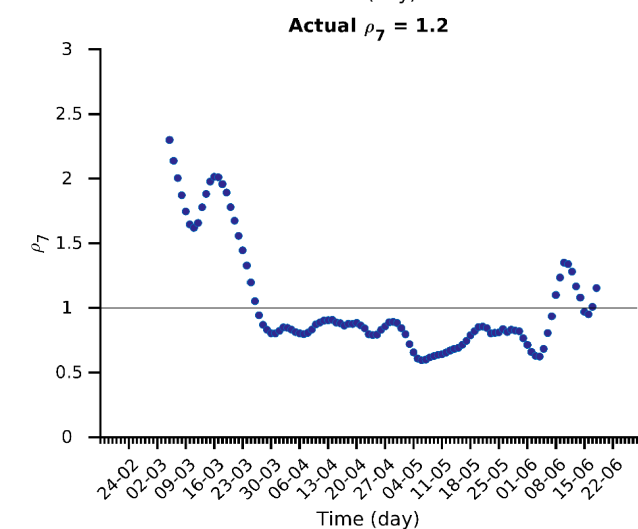
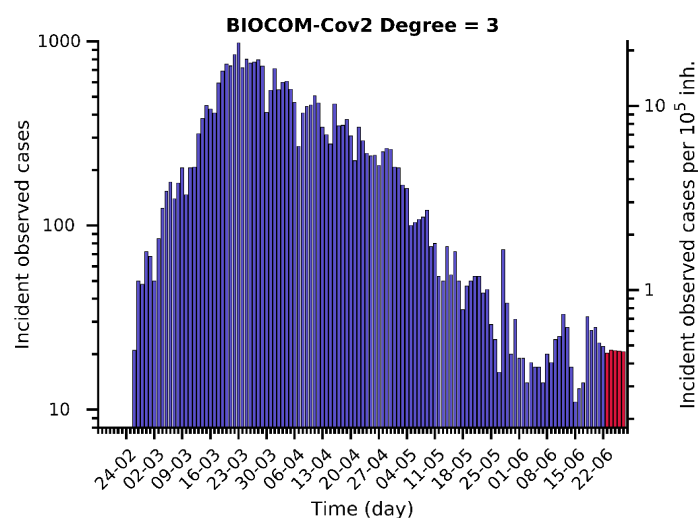
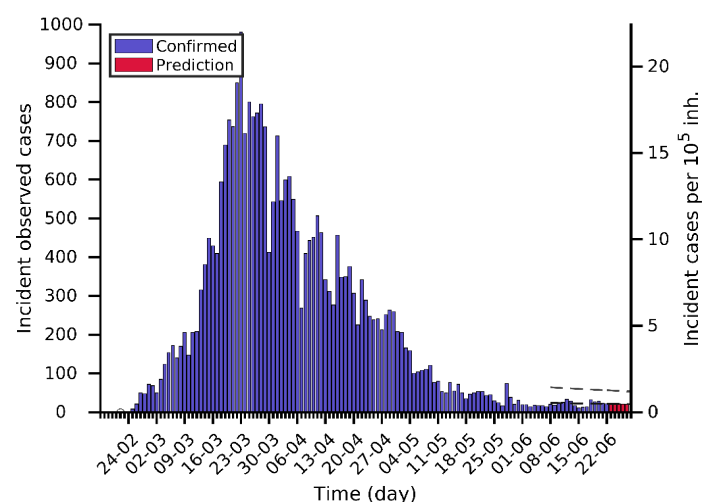
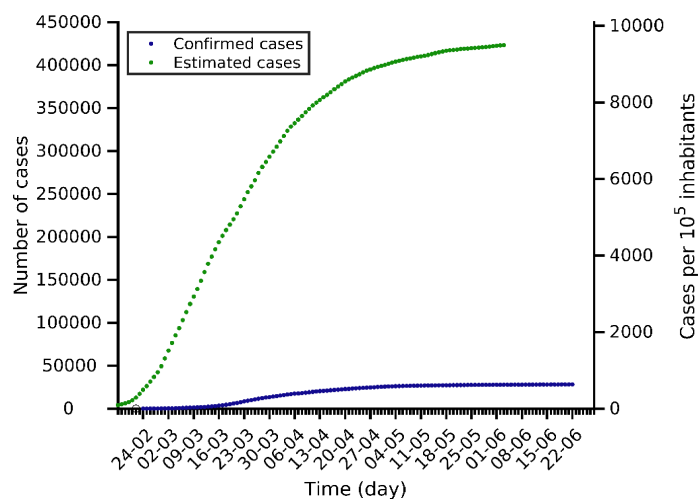
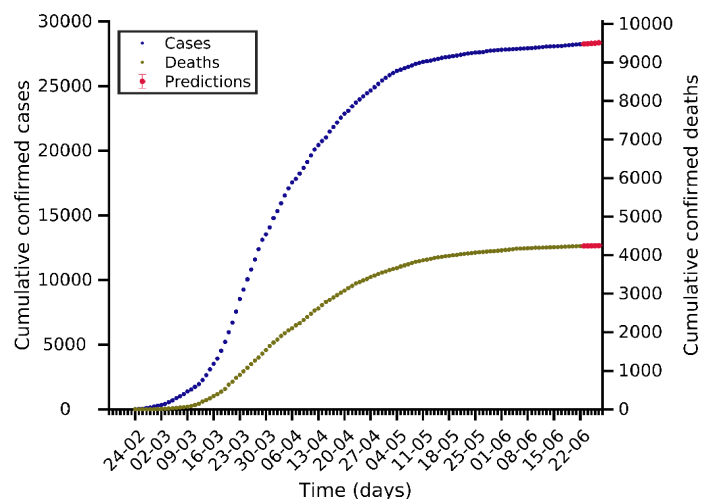
Lombardia 22-06-2020. Population: 10.1M. Current cumulative incidence: 925/10⁵



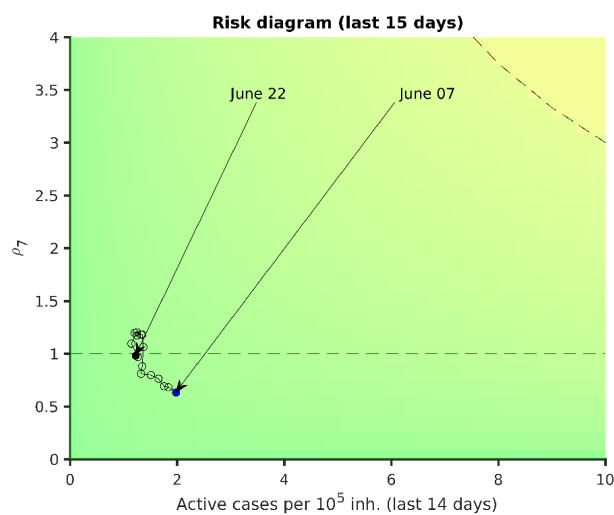
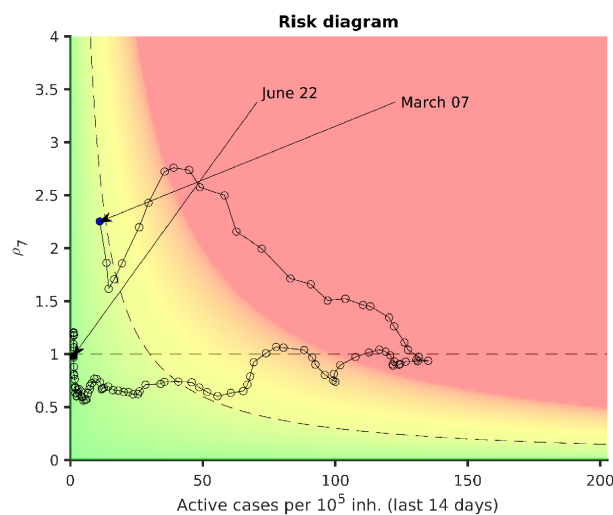
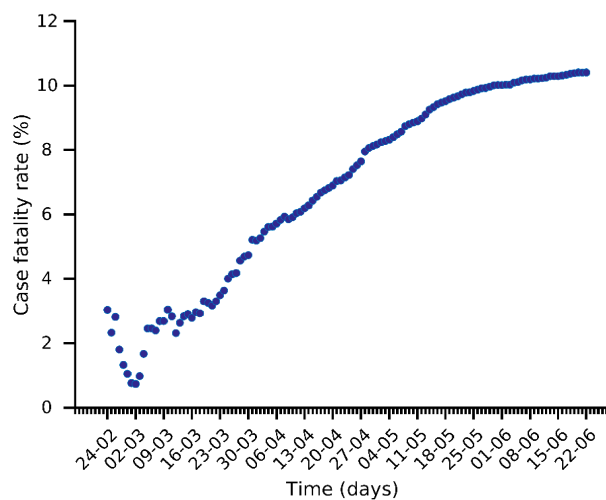
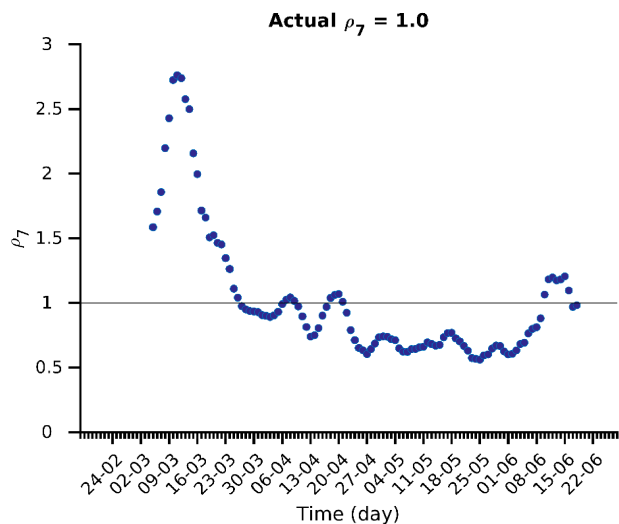
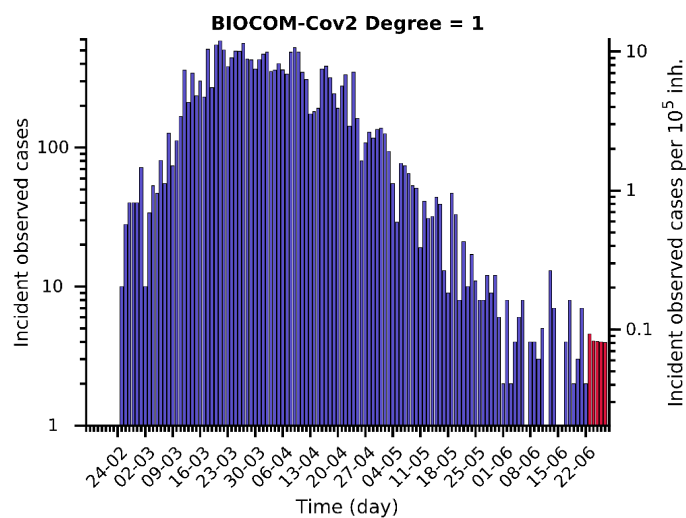
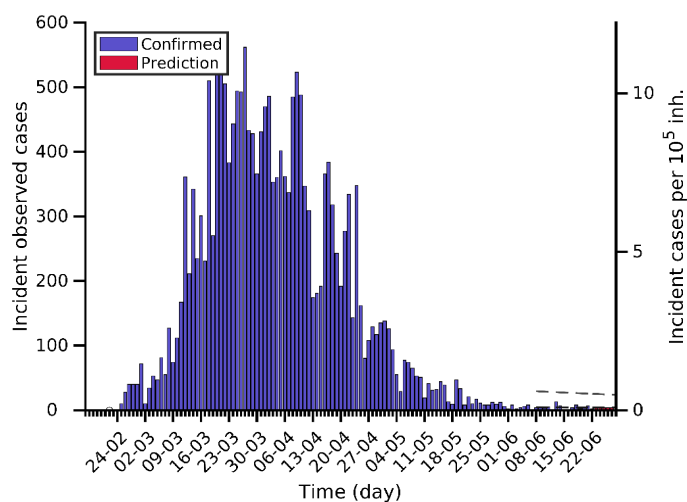
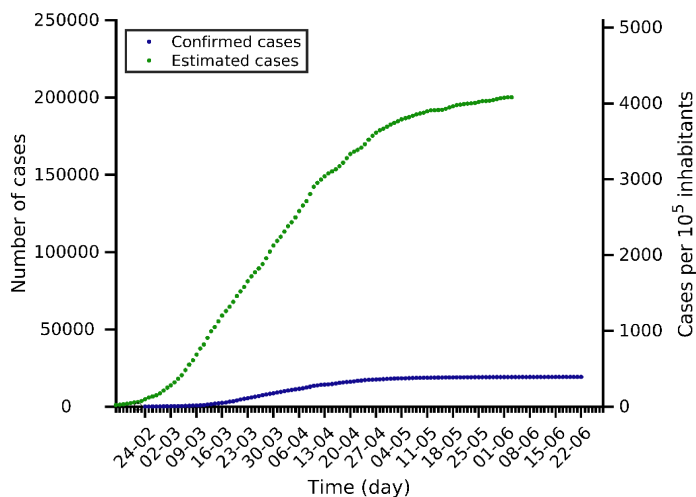
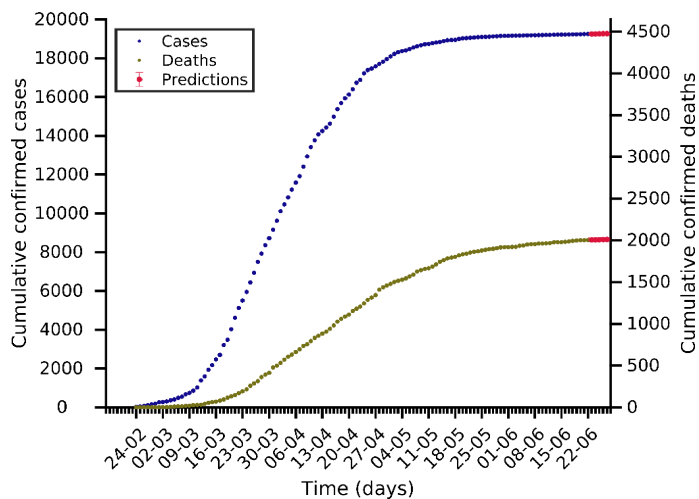
Piemonte 22-06-2020. Population: 4.4M. Current cumulative incidence: 717/10⁵



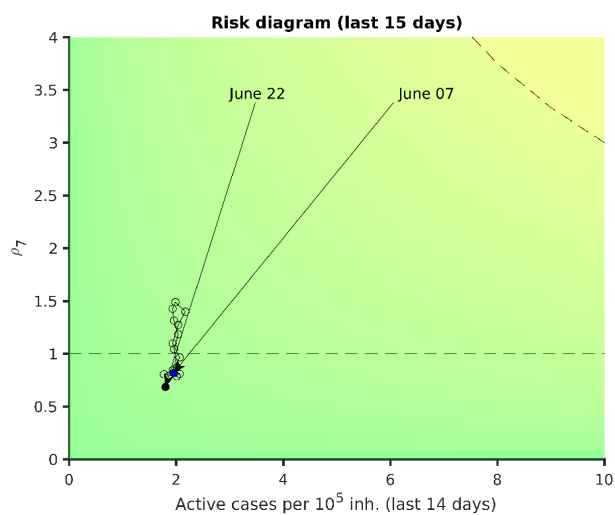
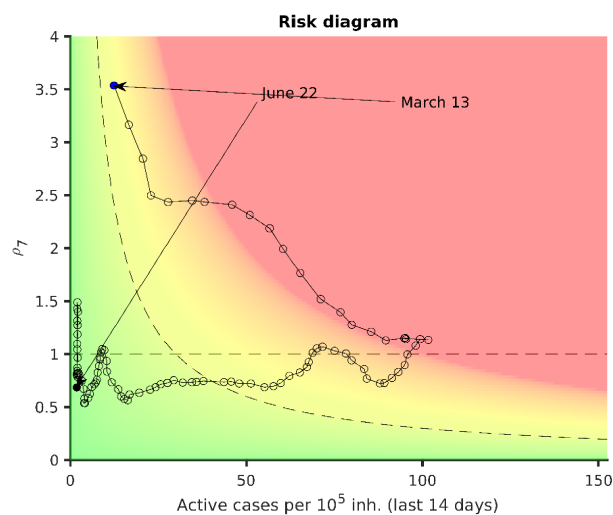
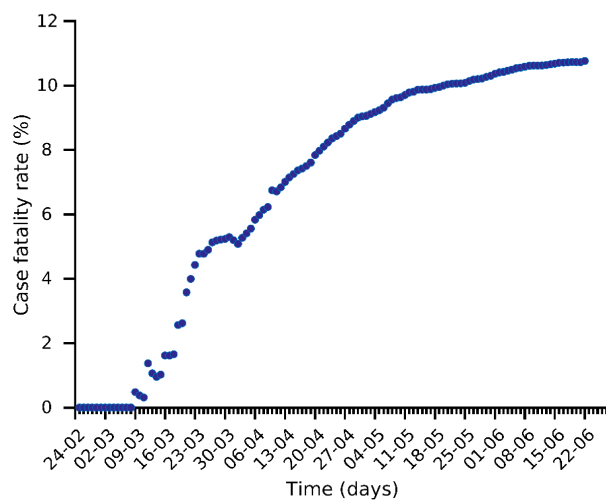
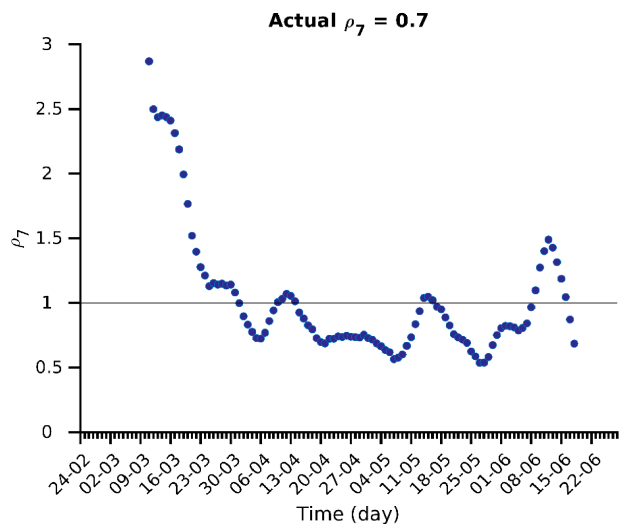
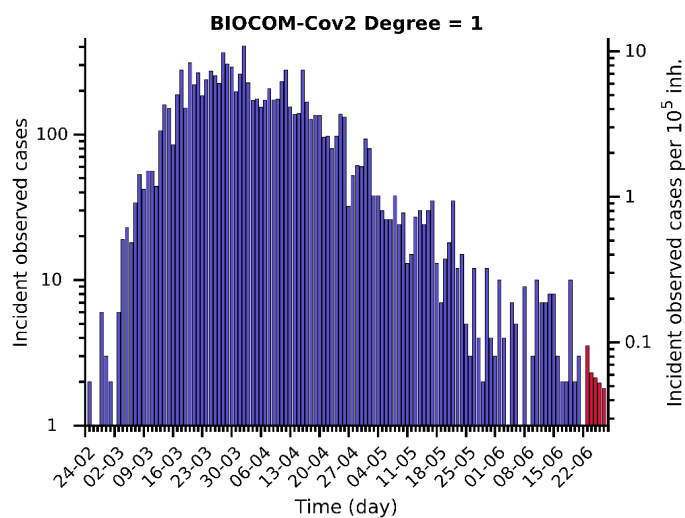
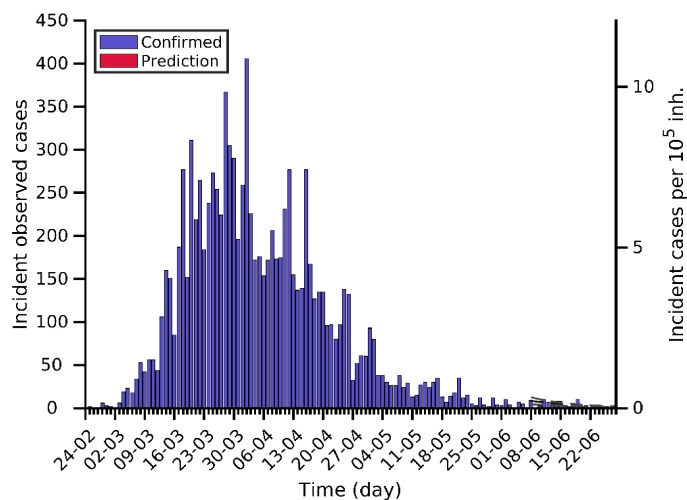
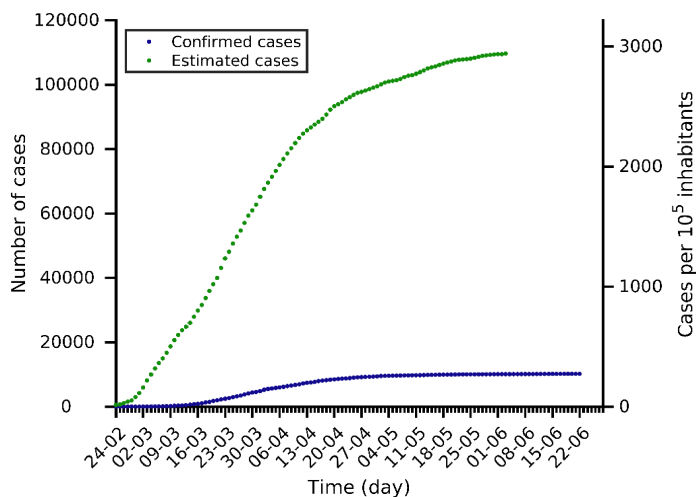
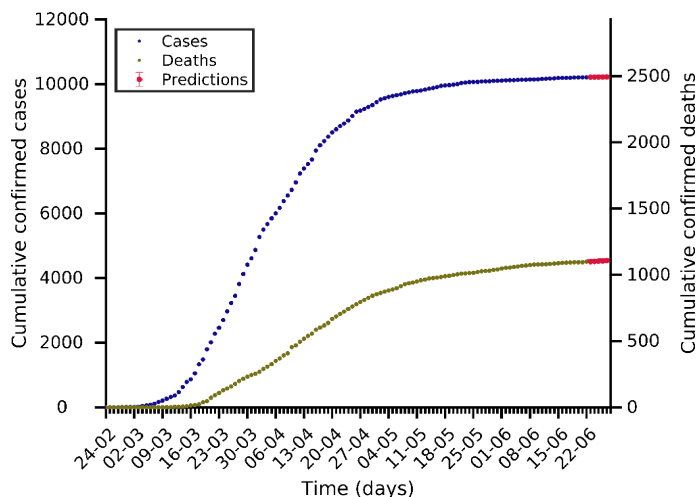
Emilia Romagna 22-06-2020. Population: 4.5M. Current cumulative incidence: 633/10⁵



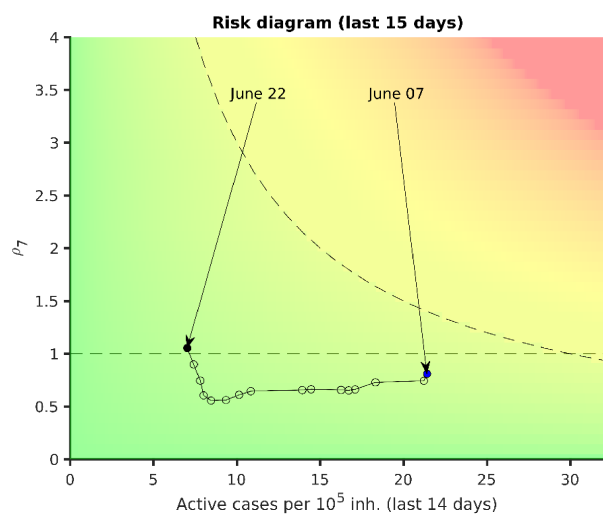
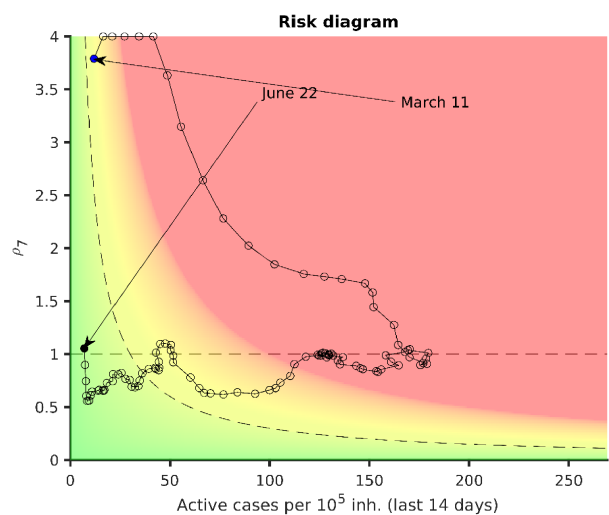
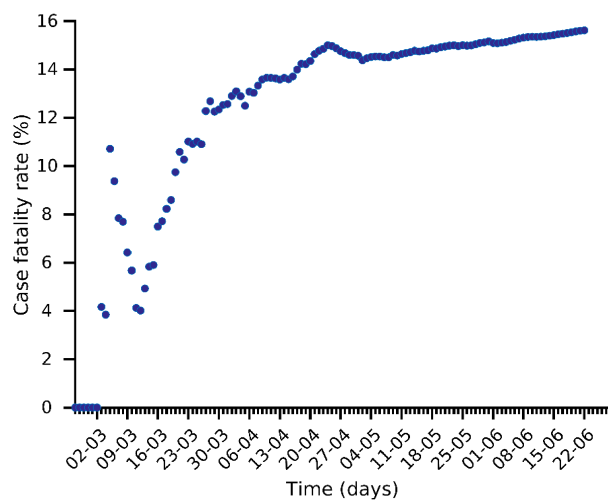
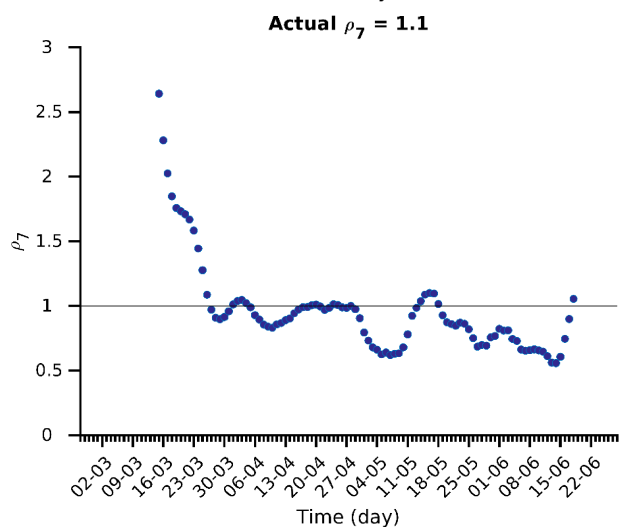
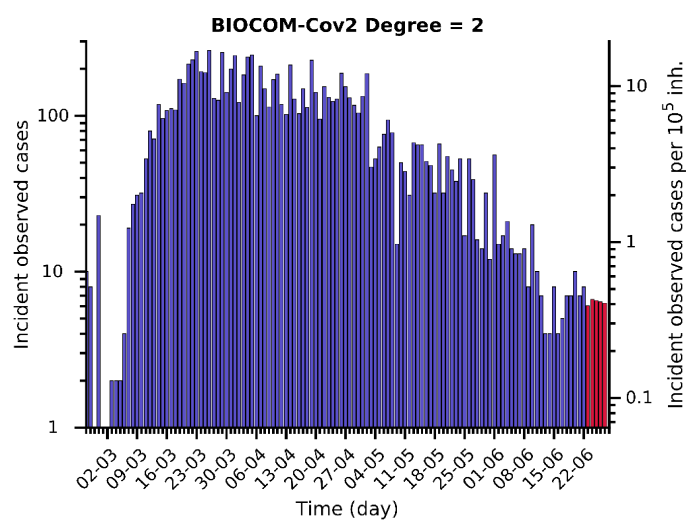
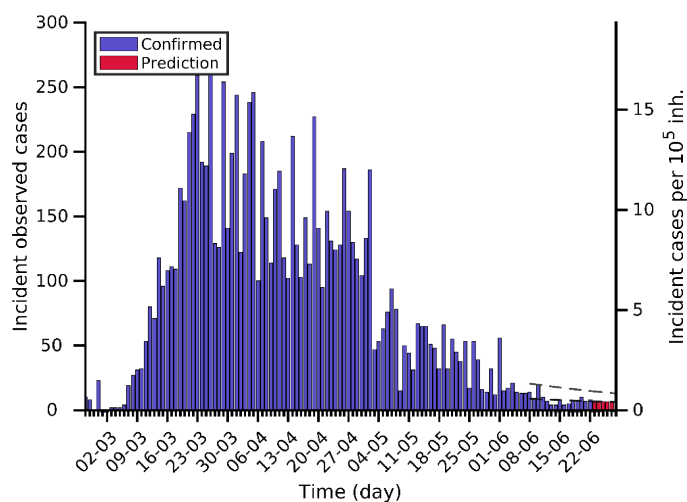
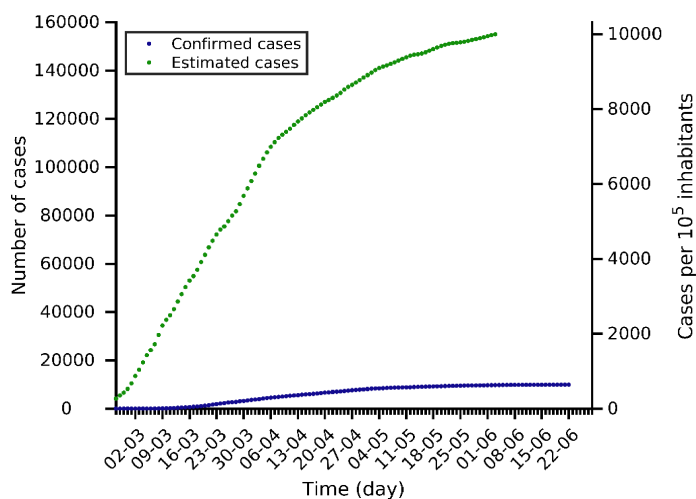
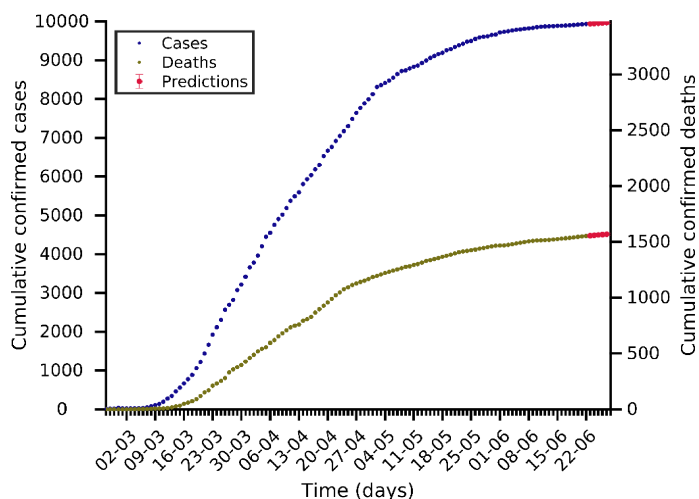
Veneto 22-06-2020. Population: 4.9M. Current cumulative incidence: 392/10⁵



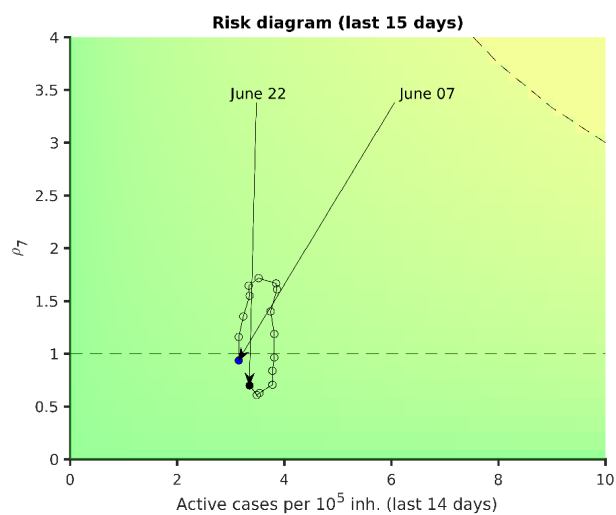
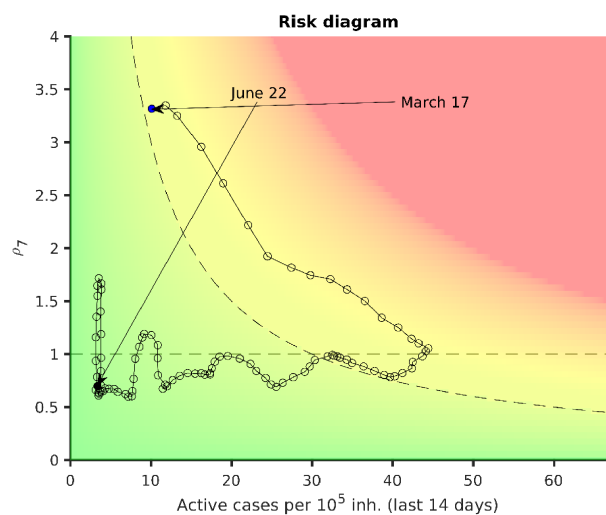
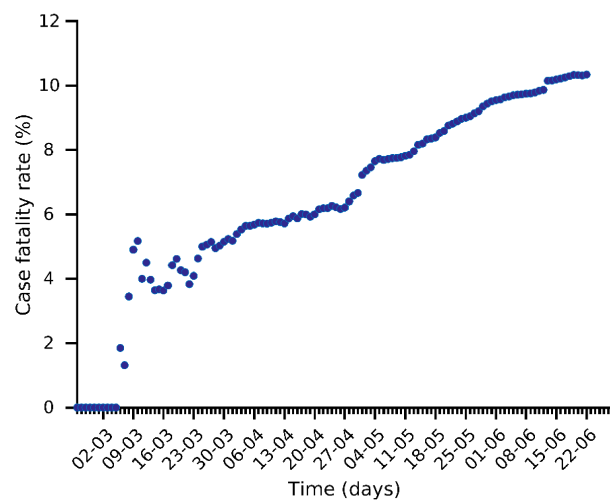
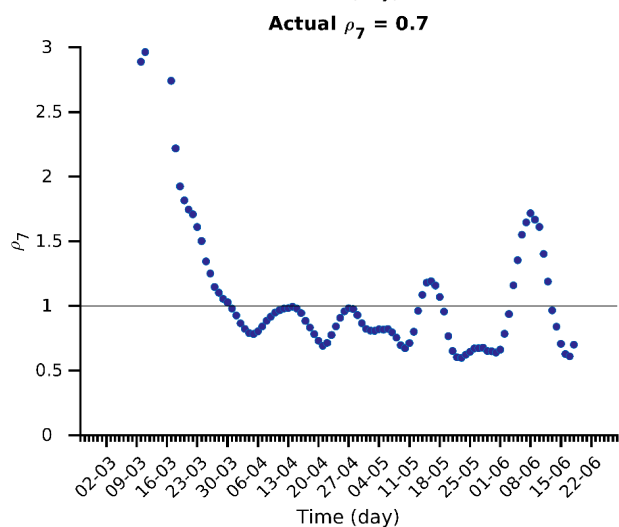
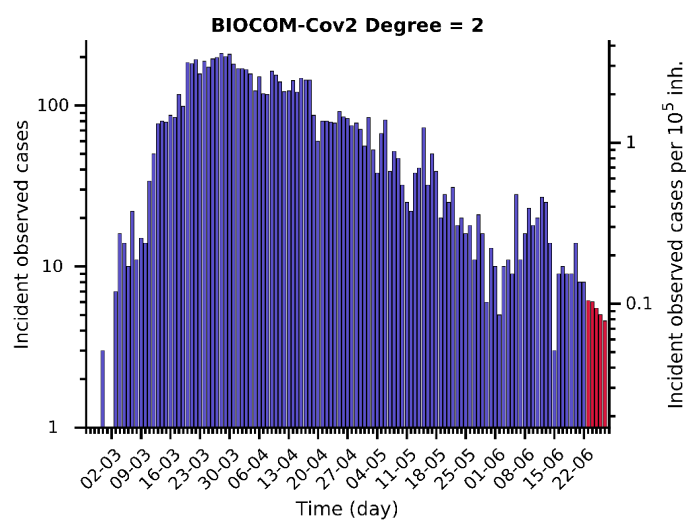
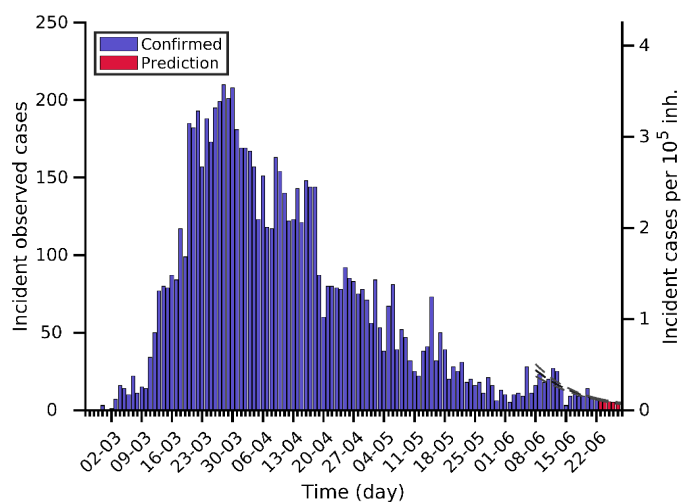
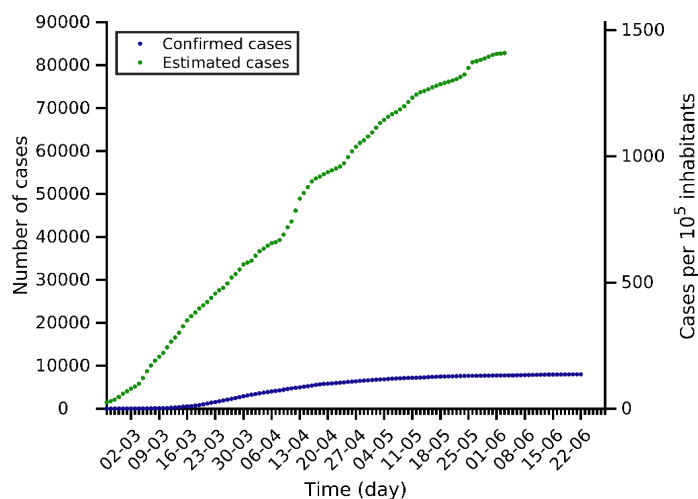
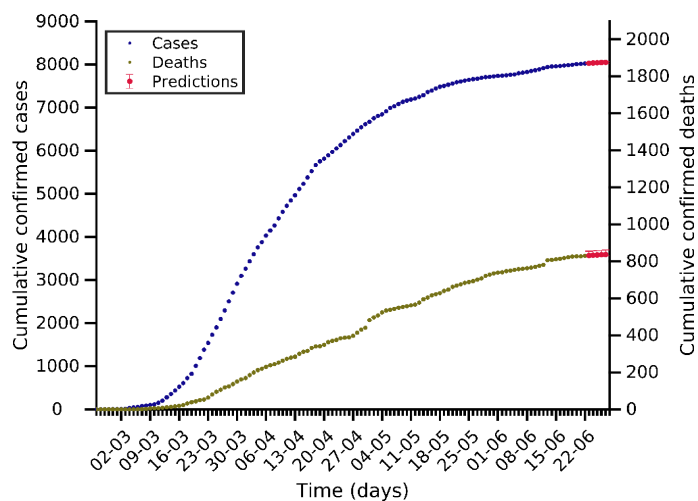
Toscana 22-06-2020. Population: 3.7M. Current cumulative incidence: 274/10⁵



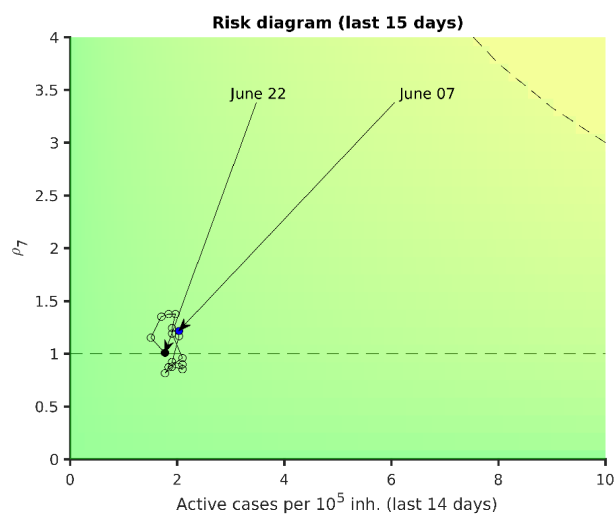
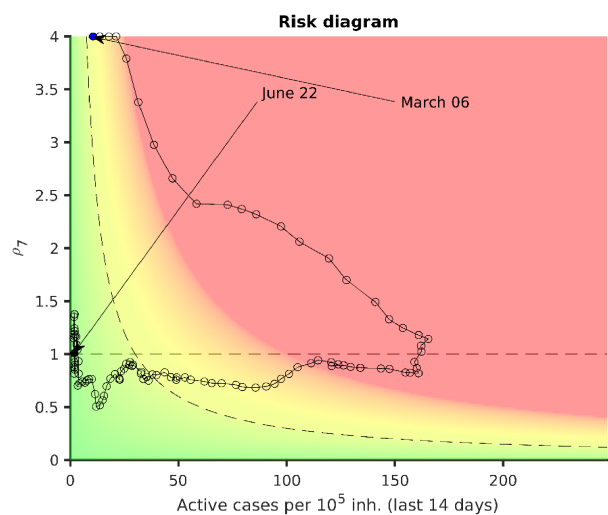
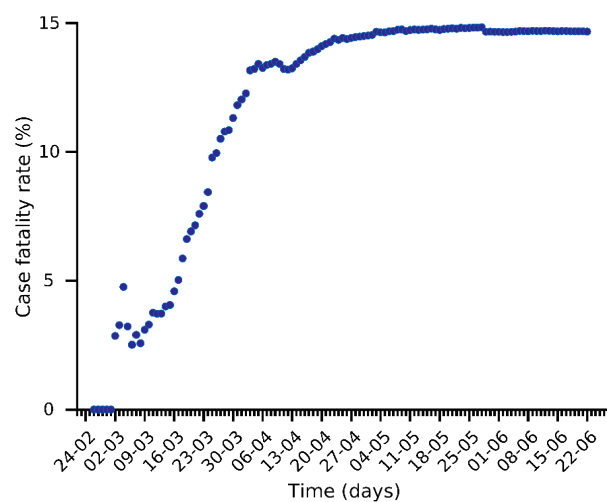
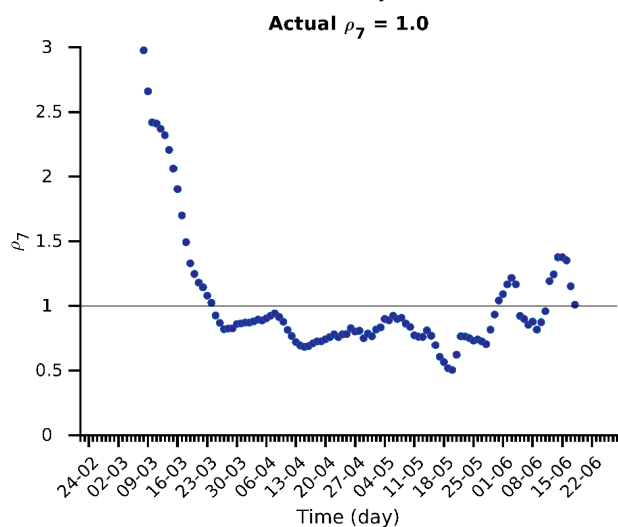
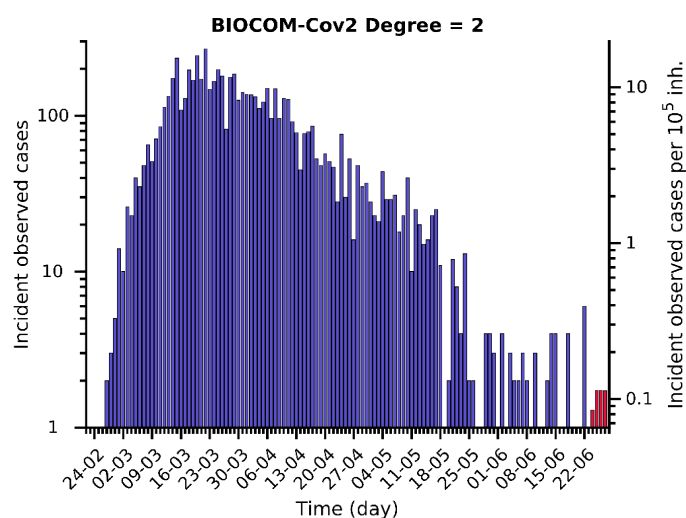
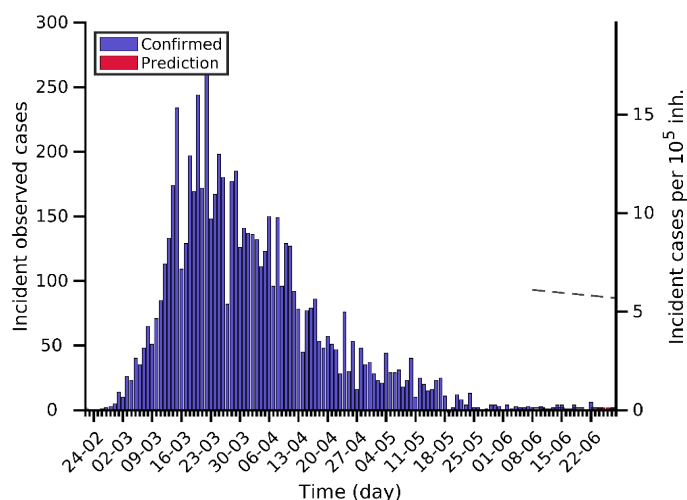
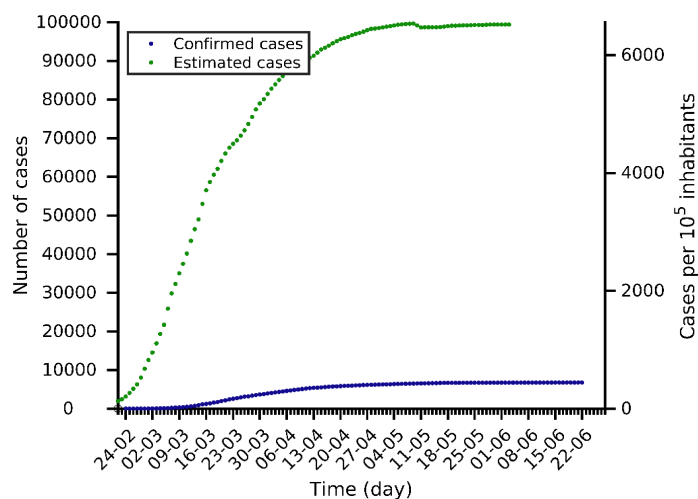
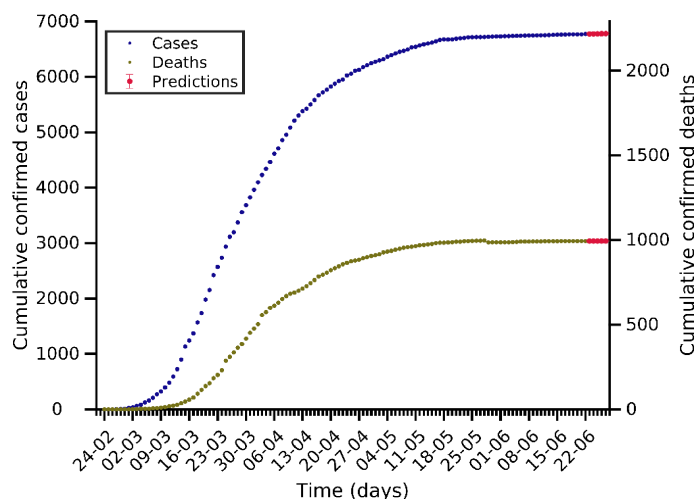
Liguria 22-06-2020. Population: 1.6M. Current cumulative incidence: 641/10⁵



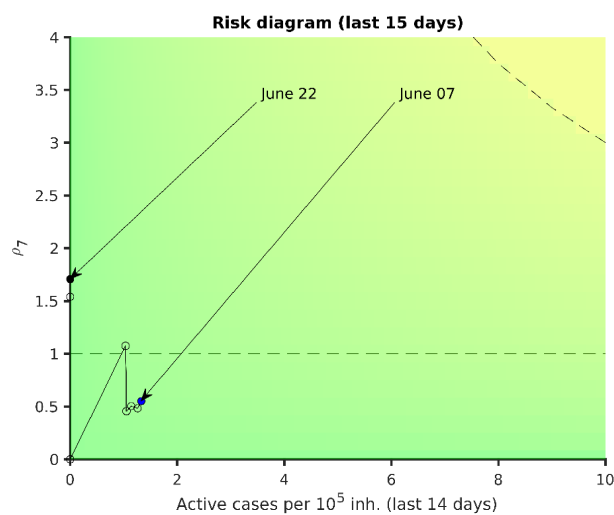
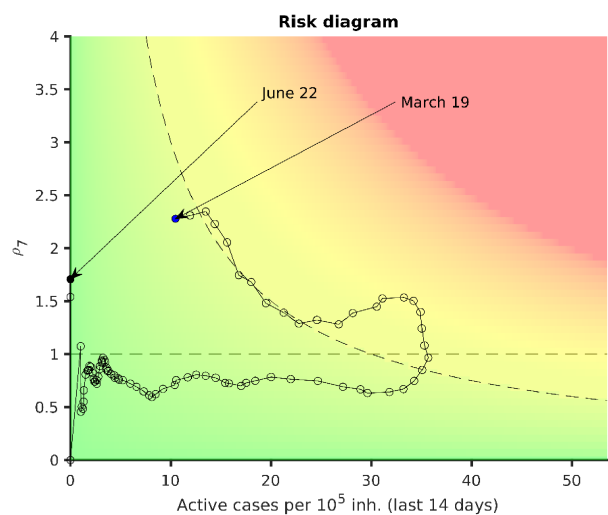
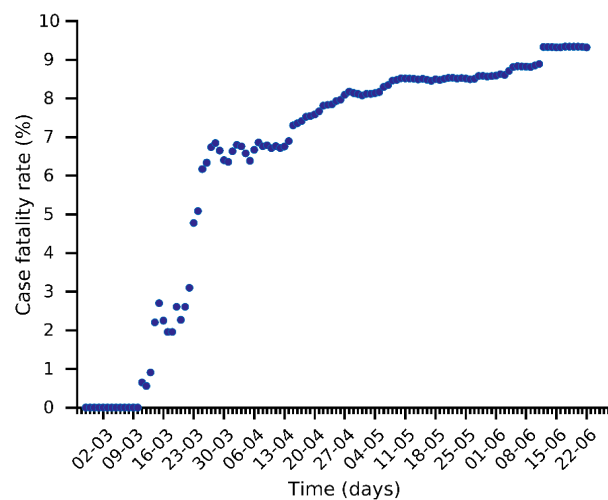
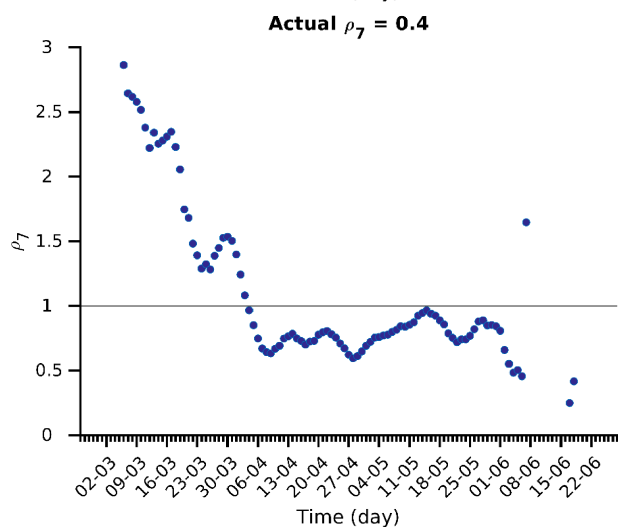
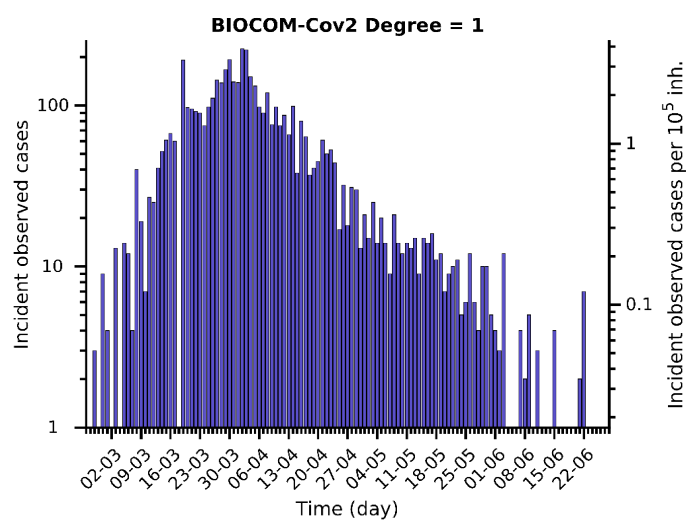
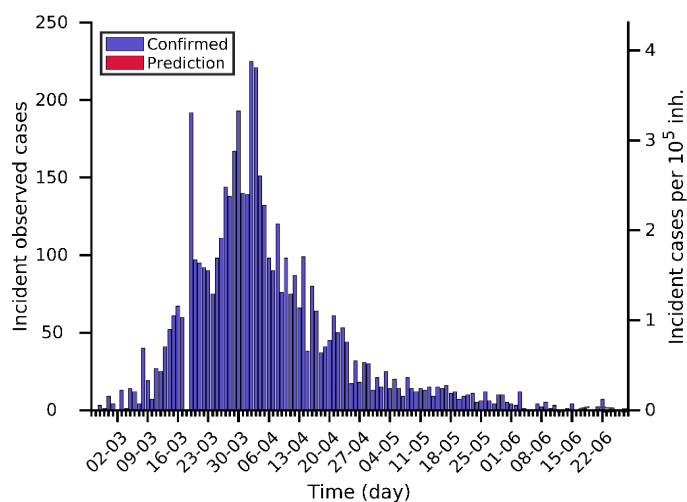
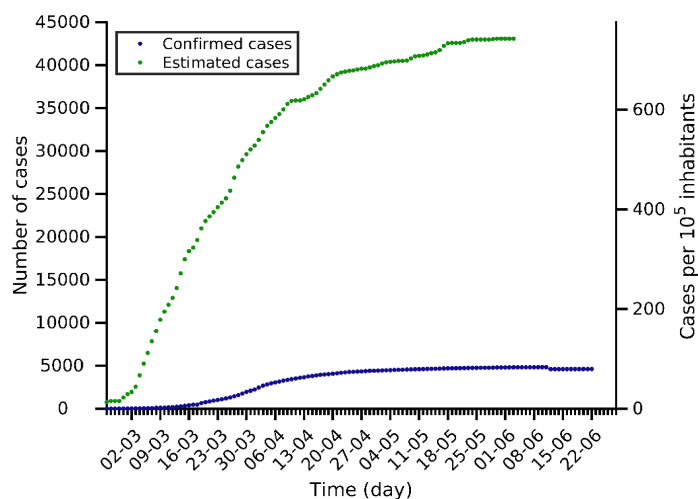
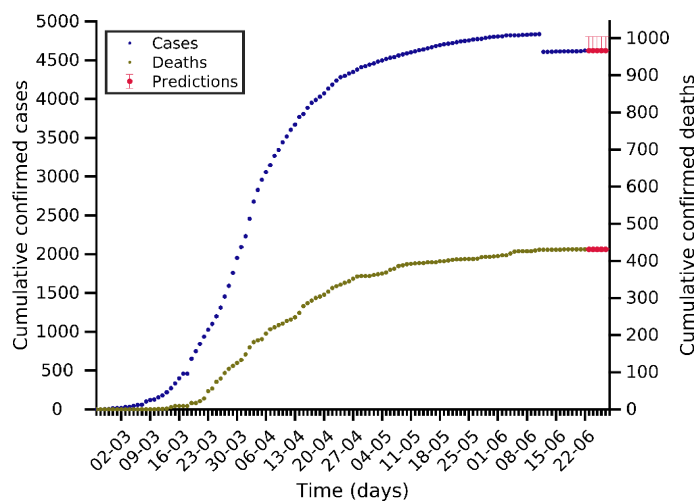
Lazio 22-06-2020. Population: 5.9M. Current cumulative incidence: 137/10⁵



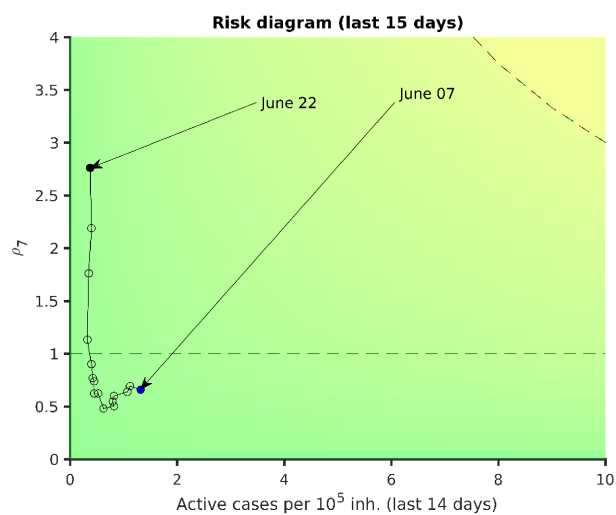
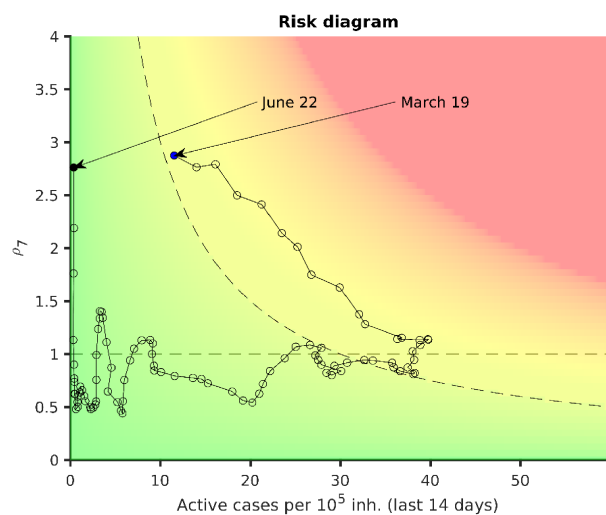
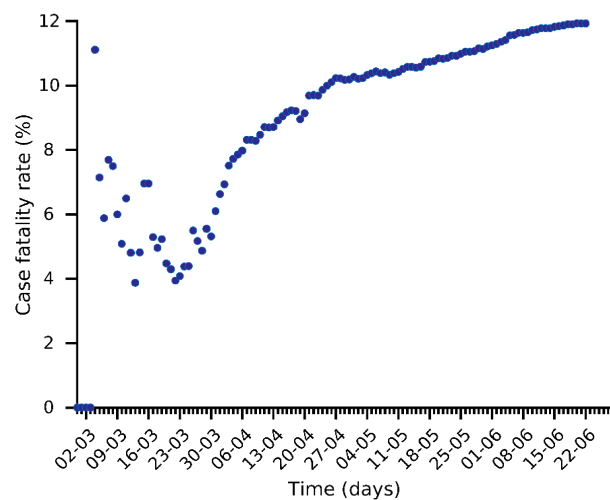
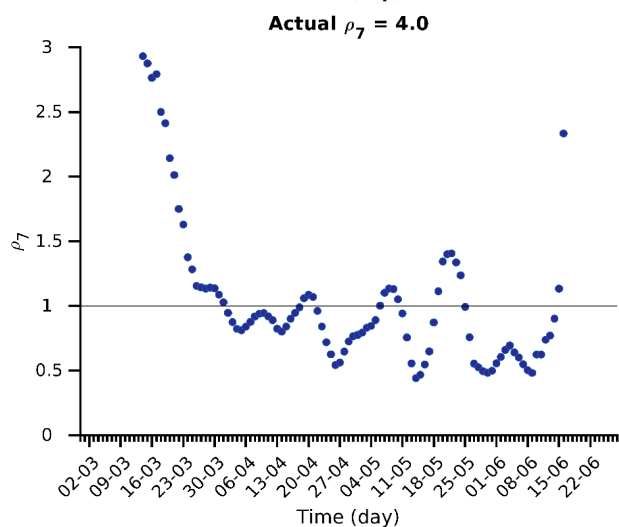
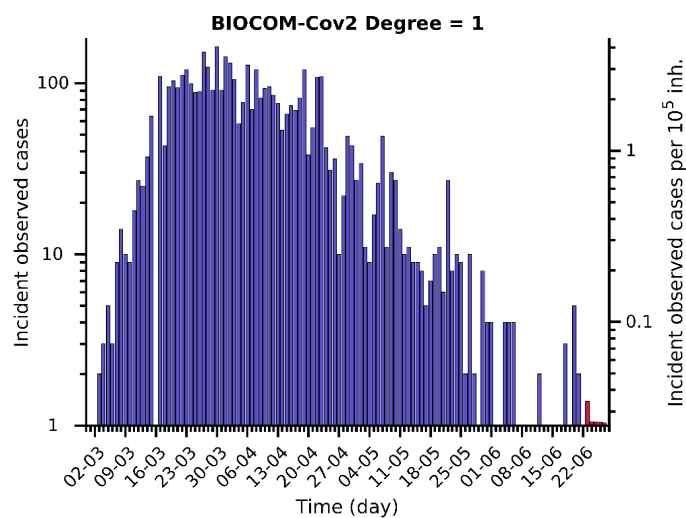
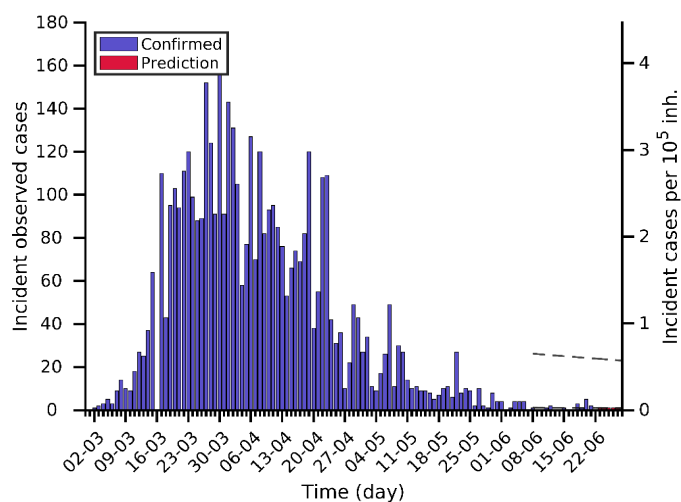
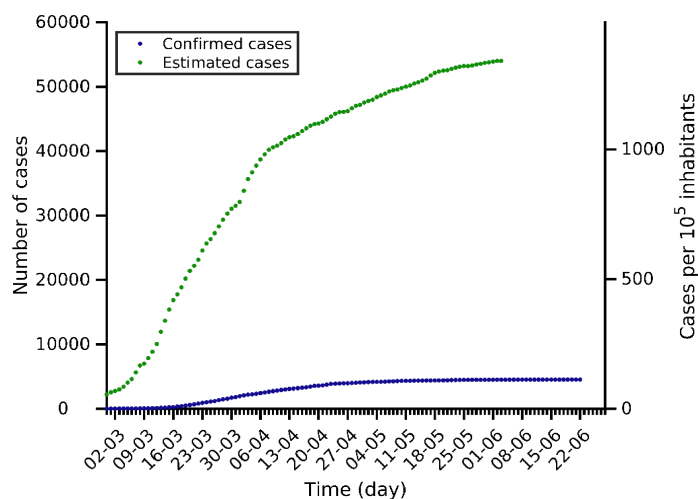
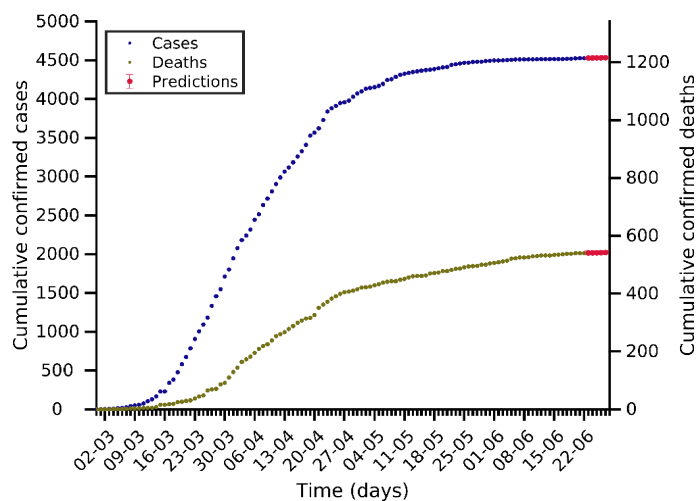
Marche 22-06-2020. Population: 1.5M. Current cumulative incidence: 444/10⁵



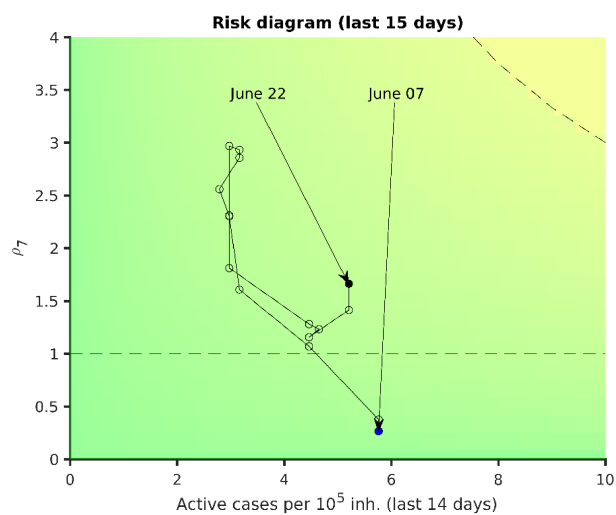
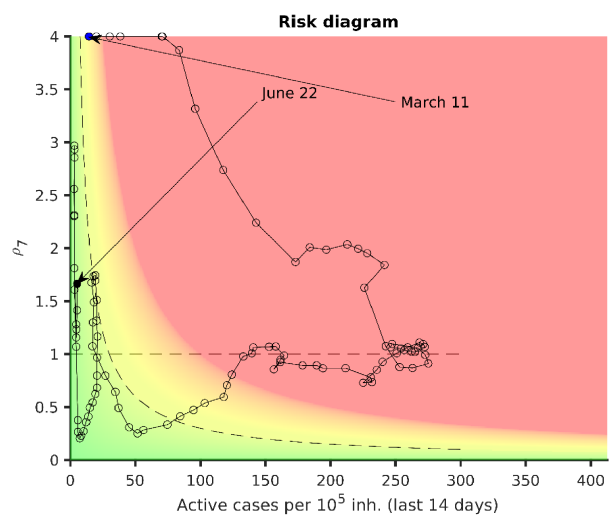
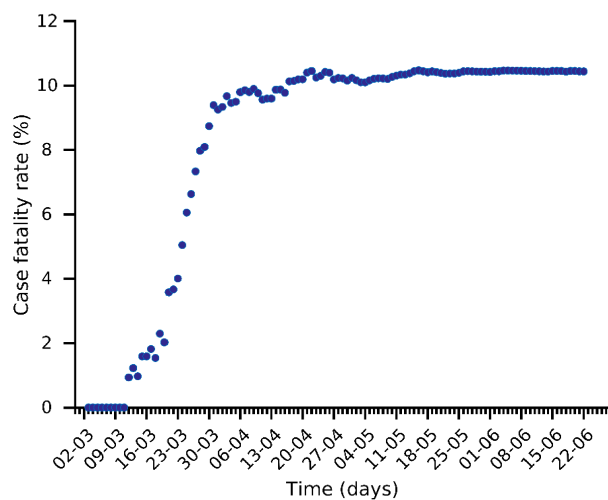
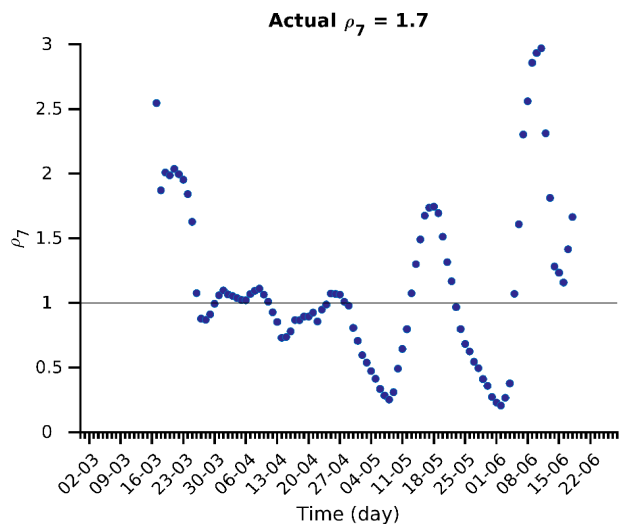
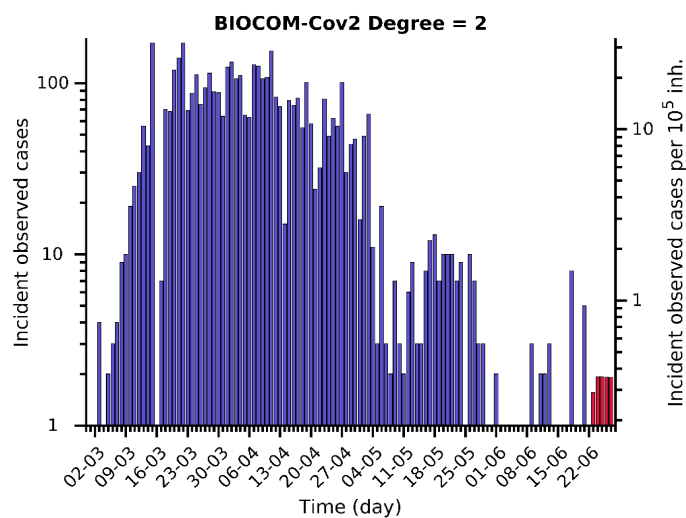
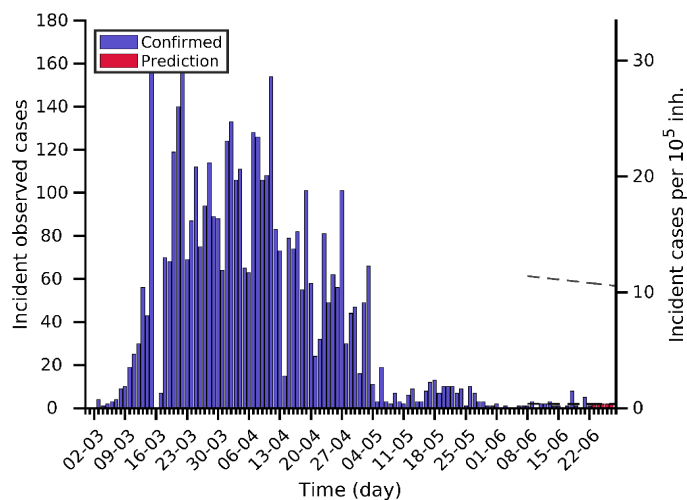
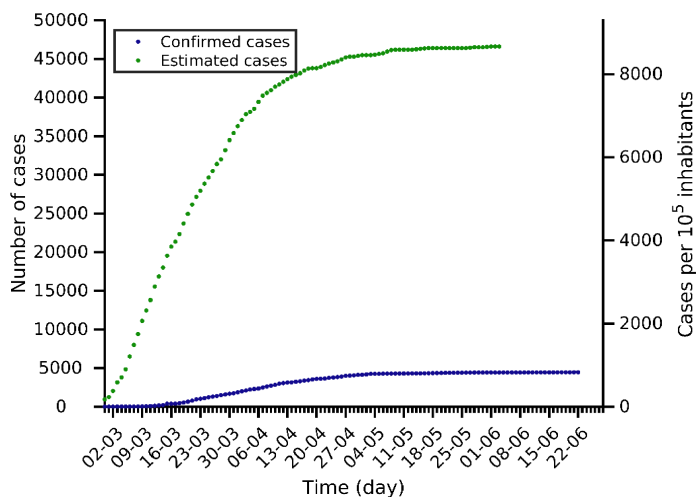
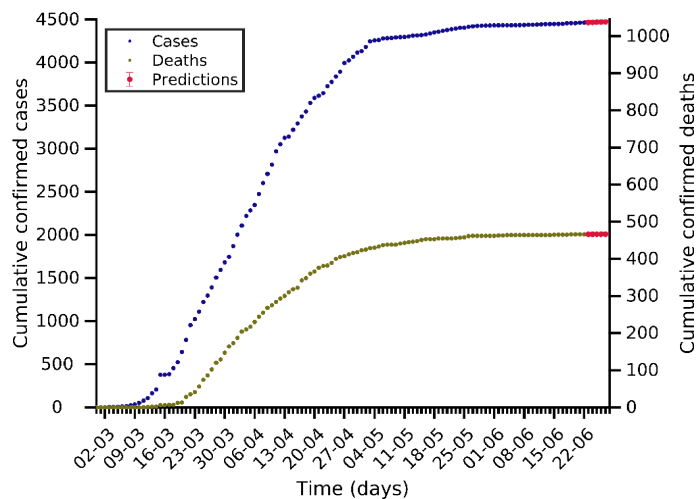
Campania 22-06-2020. Population: 5.8M. Current cumulative incidence: 80/10⁵



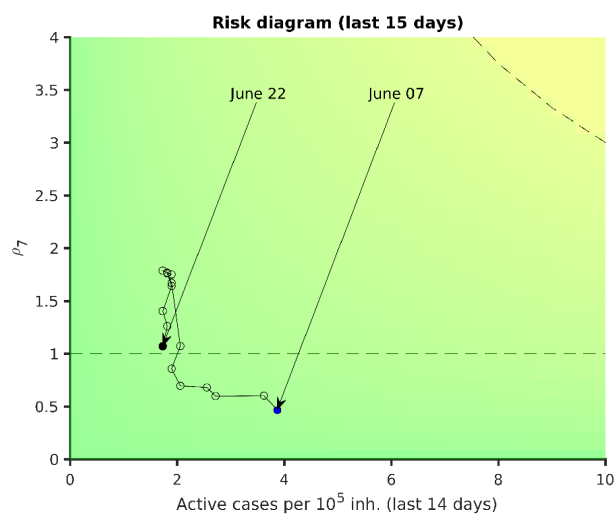
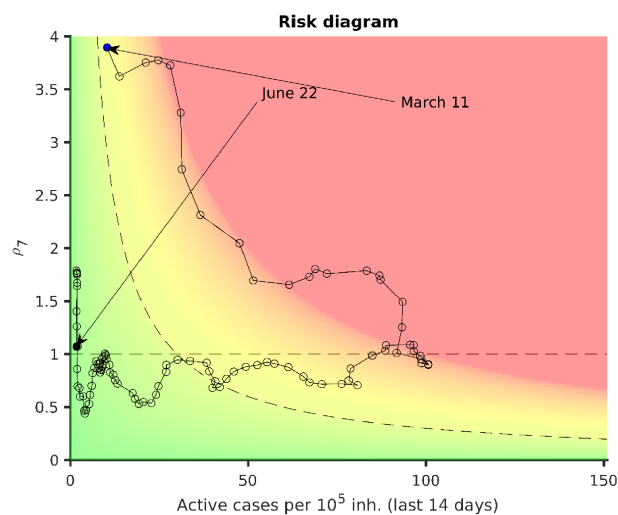
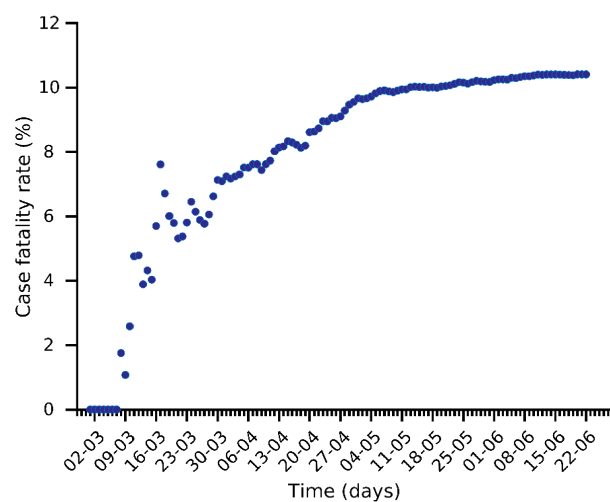
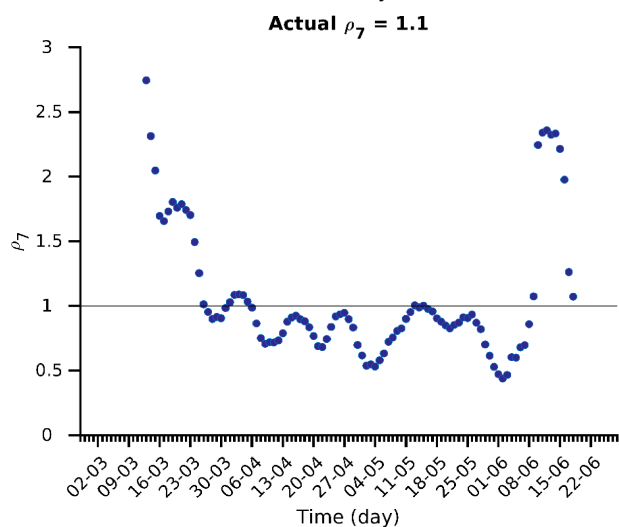
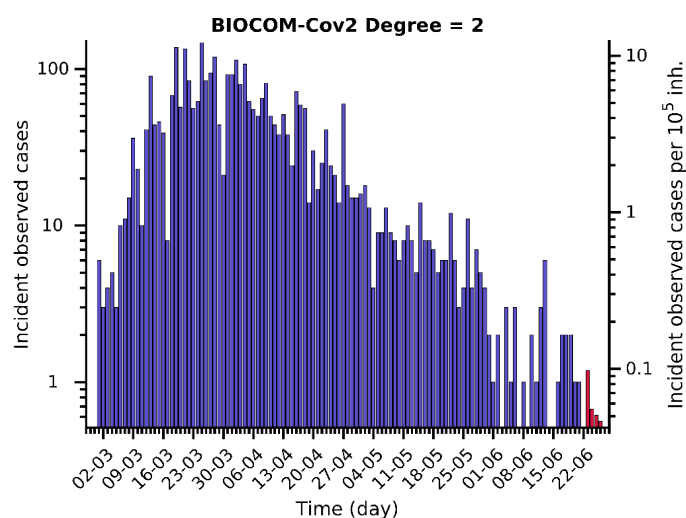
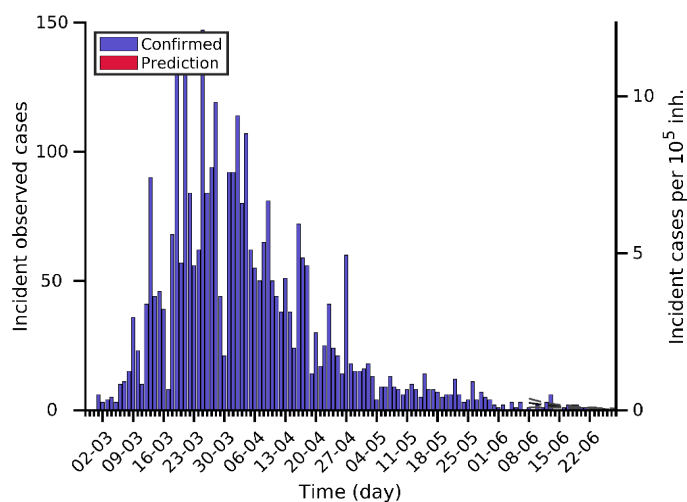
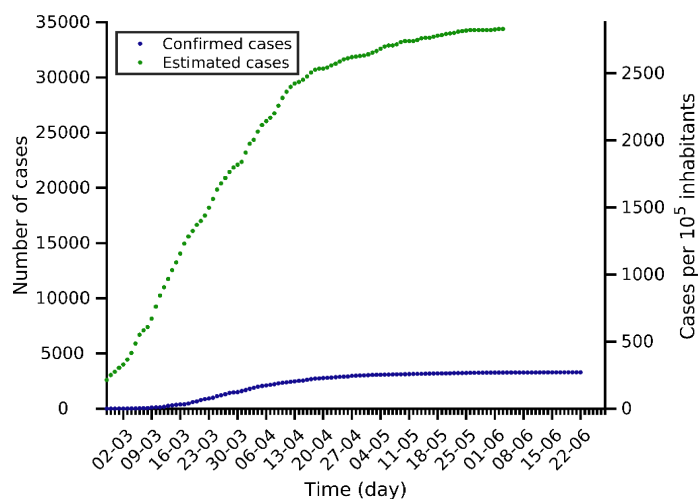
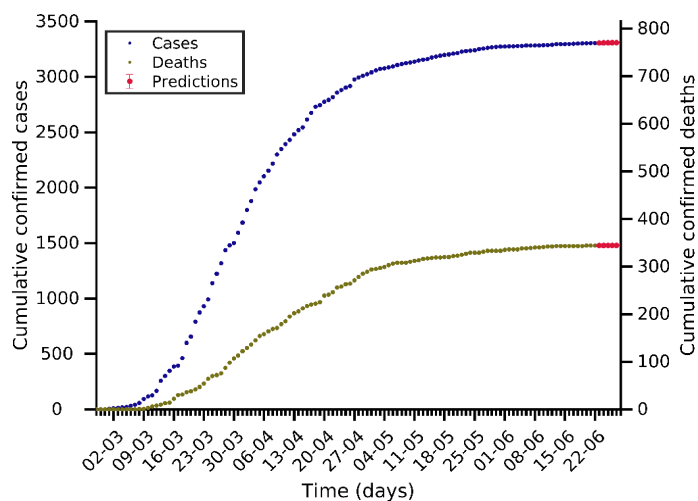
Puglia 22-06-2020. Population: 4.0M. Current cumulative incidence: 112/10⁵



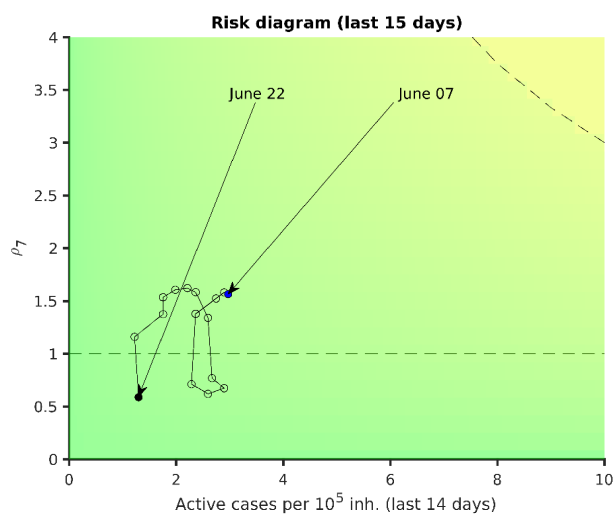
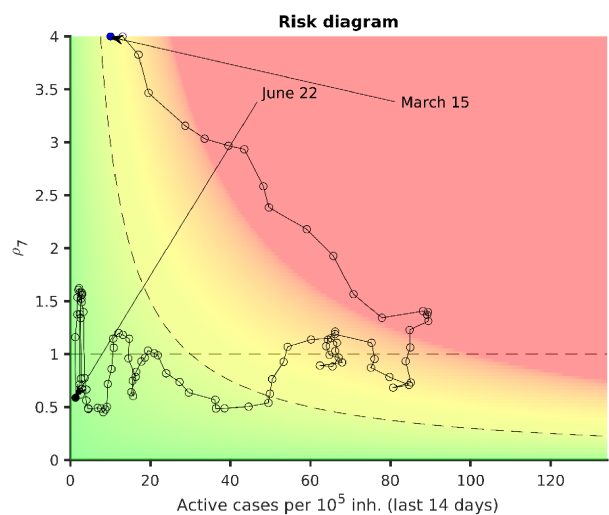
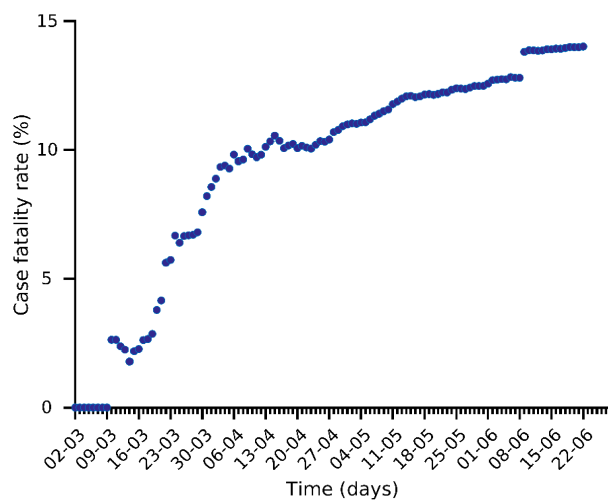
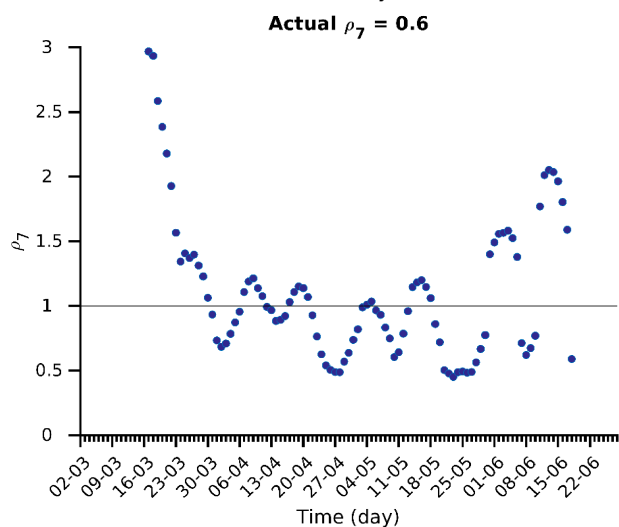
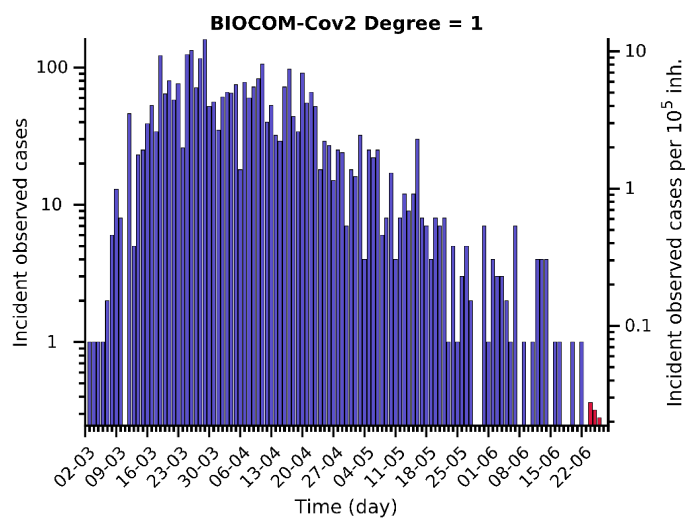
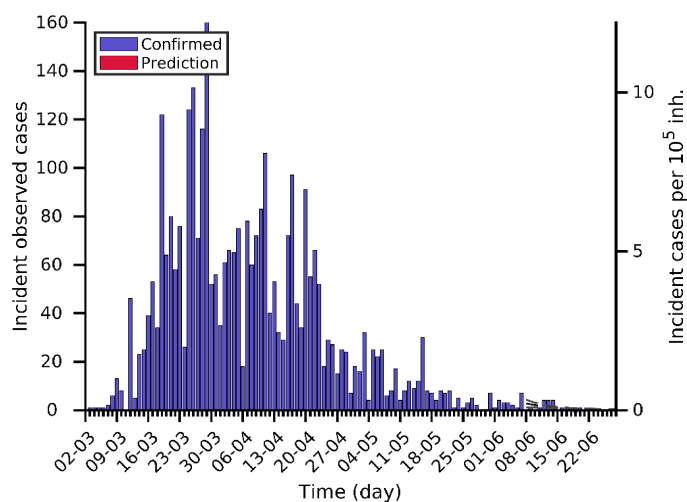
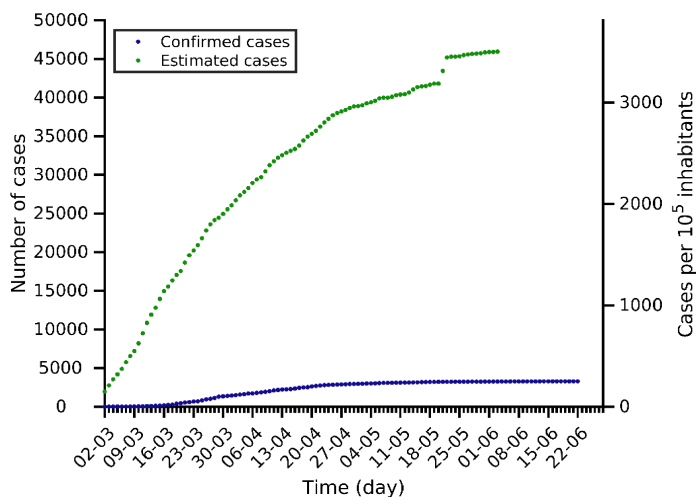
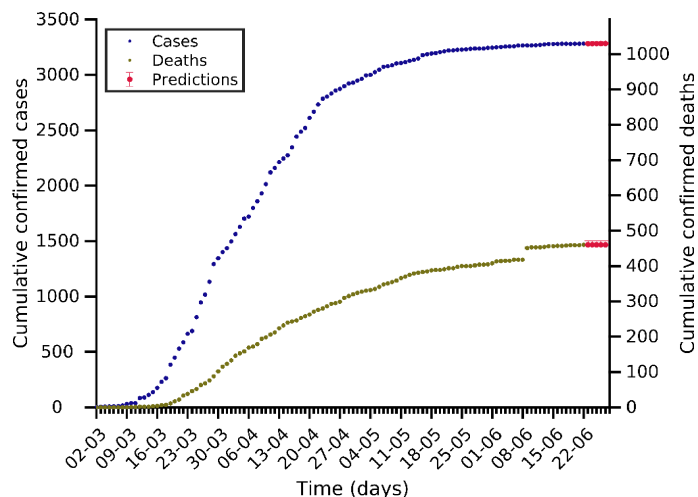
Trento 22-06-2020. Population: 0.5M. Current cumulative incidence: 830/10⁵



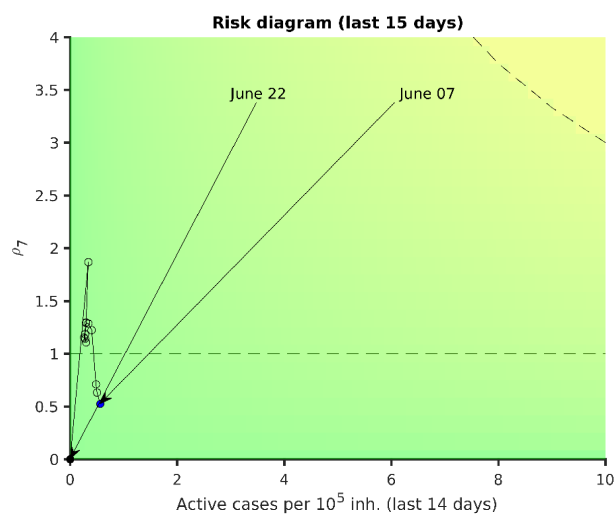
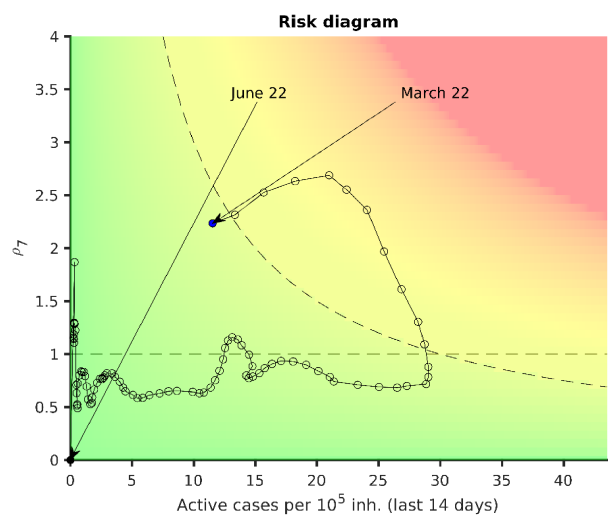
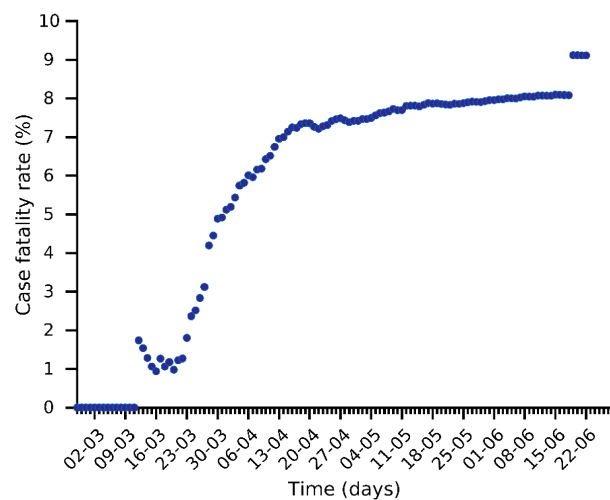
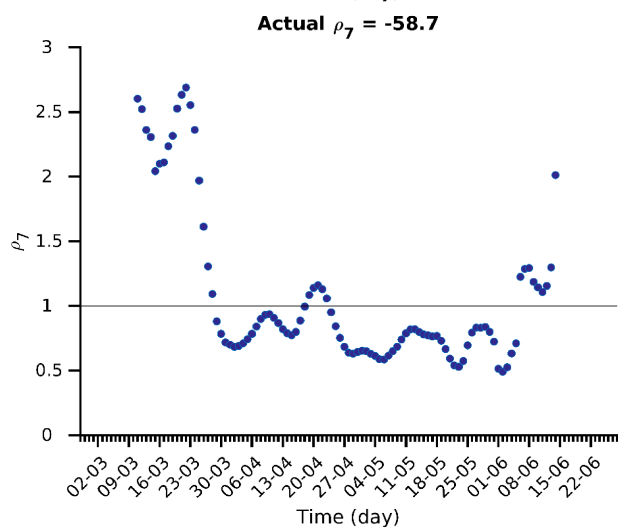
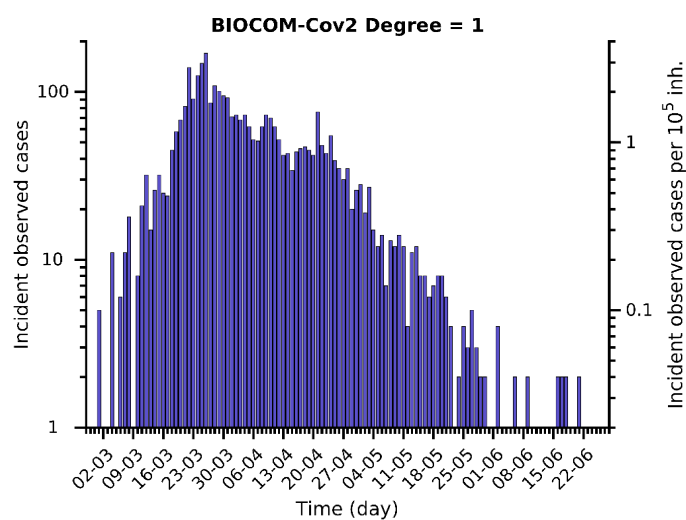
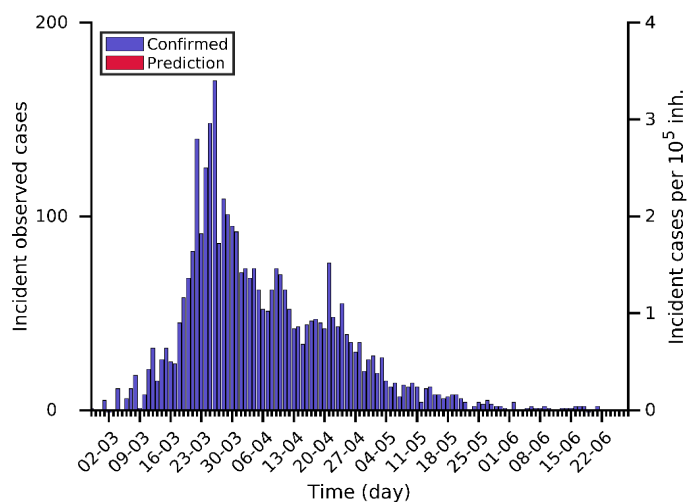
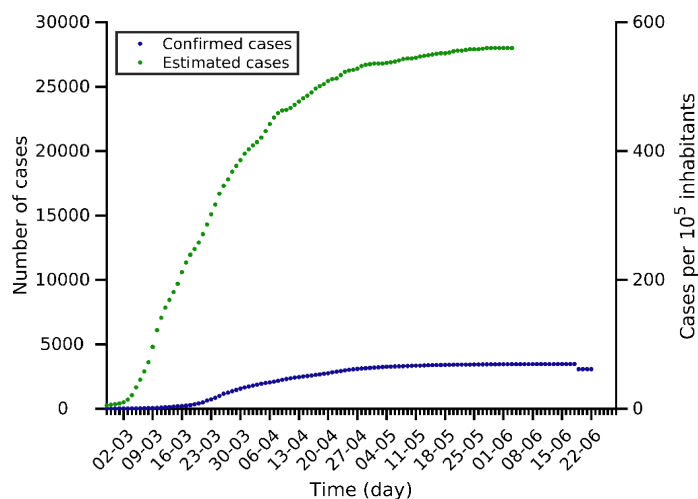
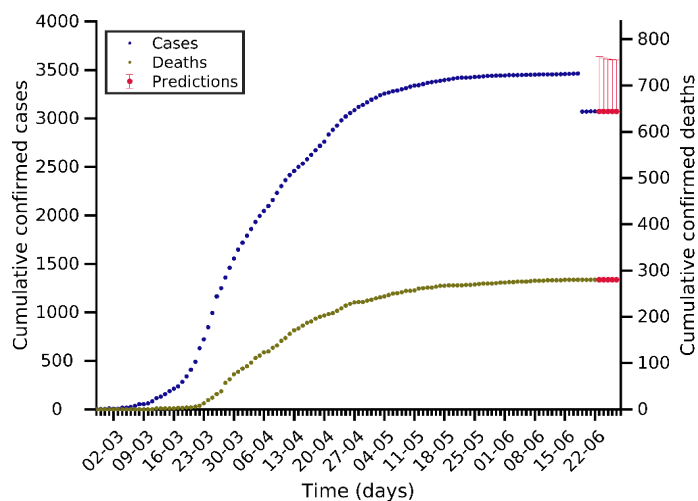
Friuli Venezia Giulia 22-06-2020. Population: 1.2M. Current cumulative incidence: 2



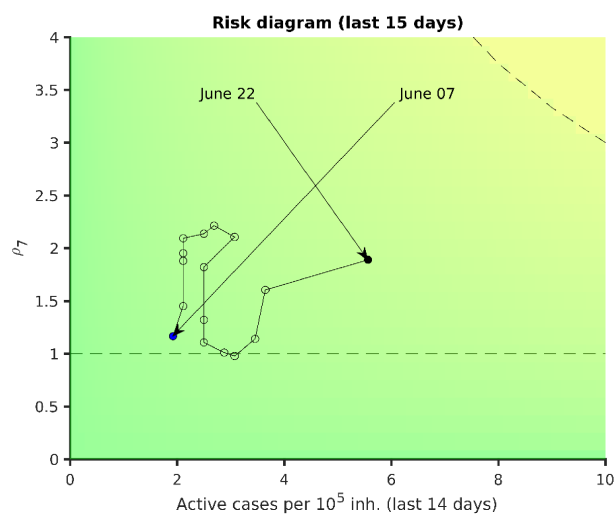
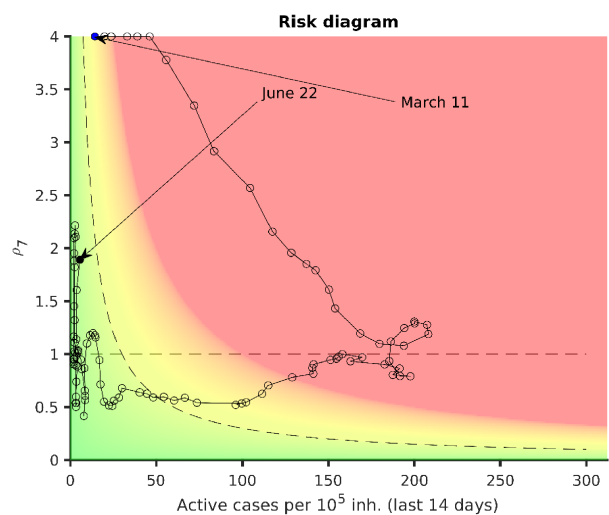
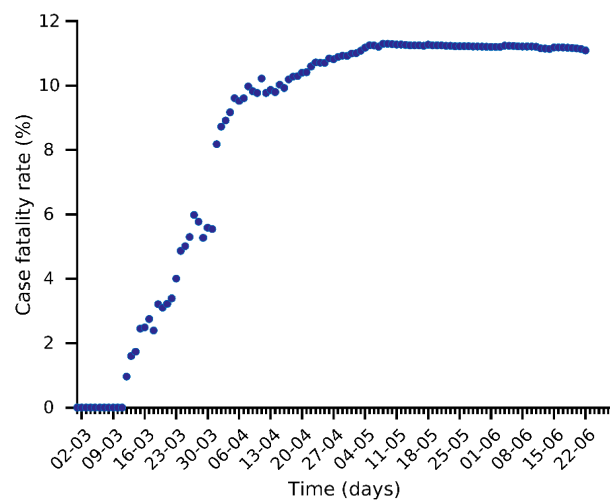
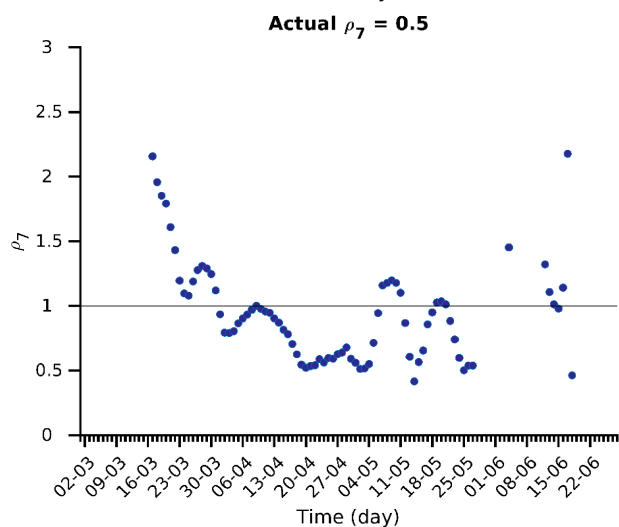
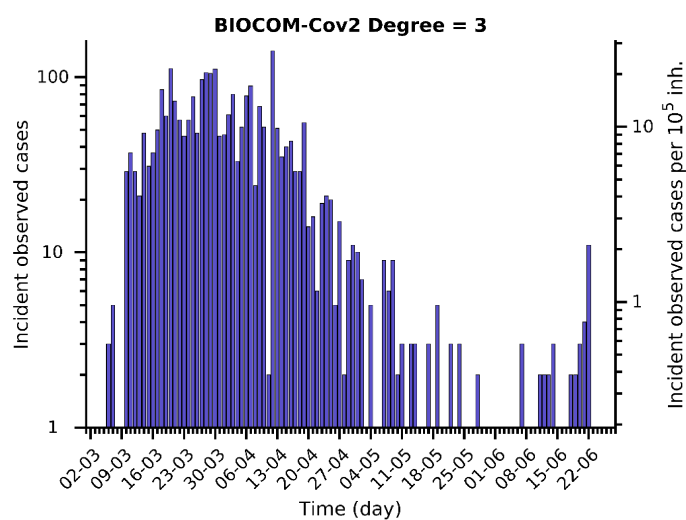
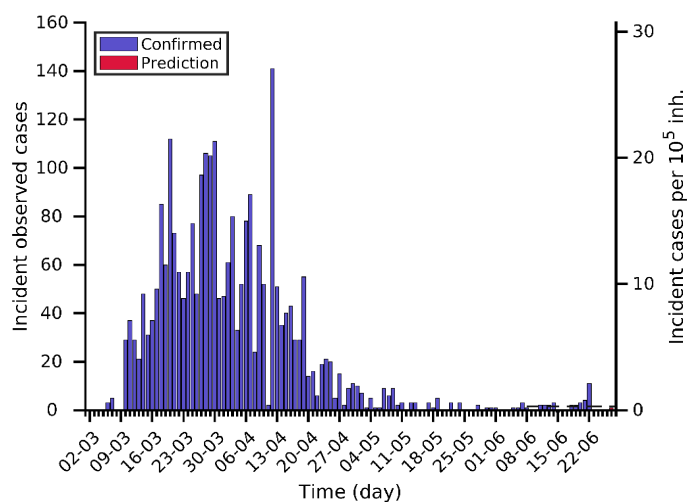
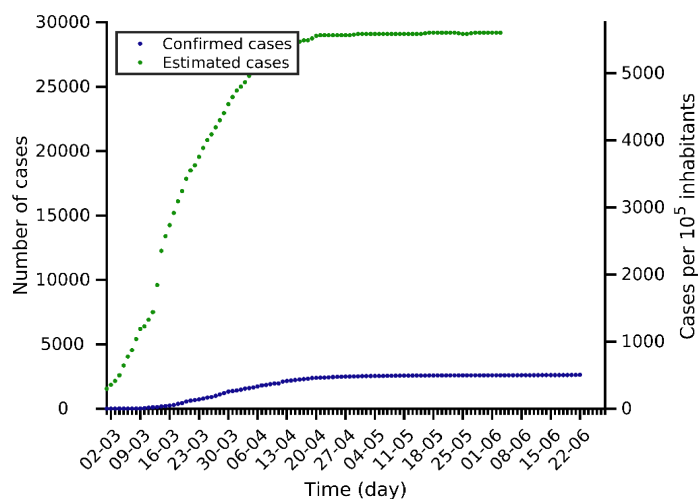
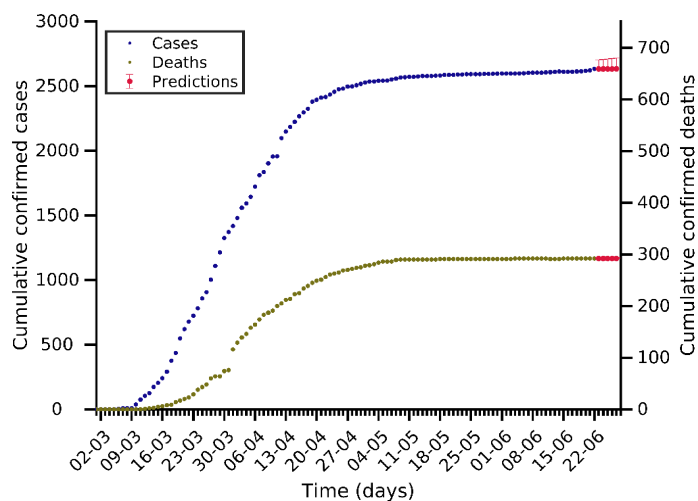
Abruzzo 22-06-2020. Population: 1.3M. Current cumulative incidence: 250/10⁵



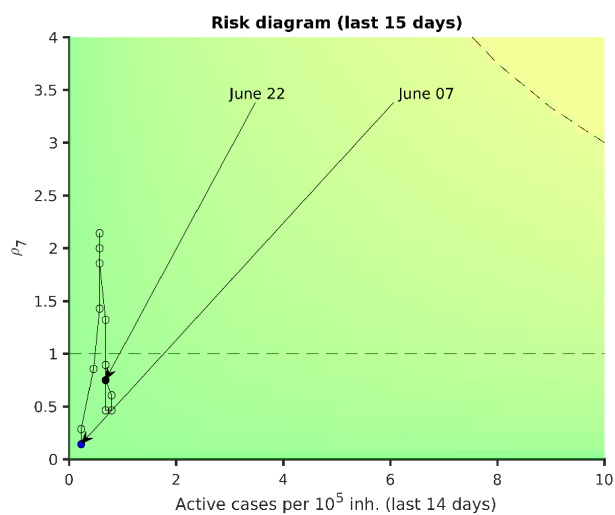
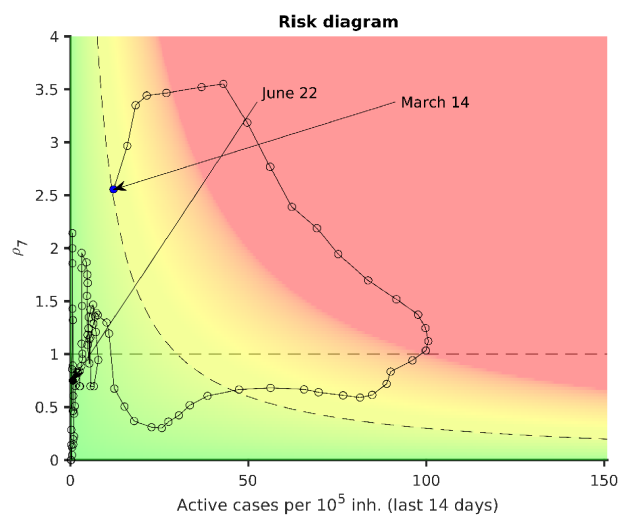
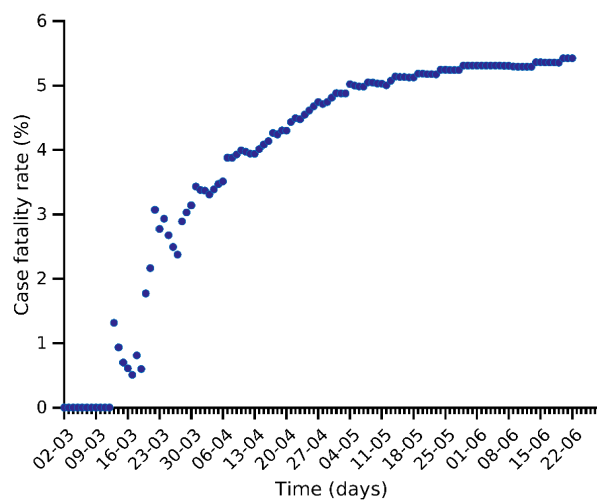
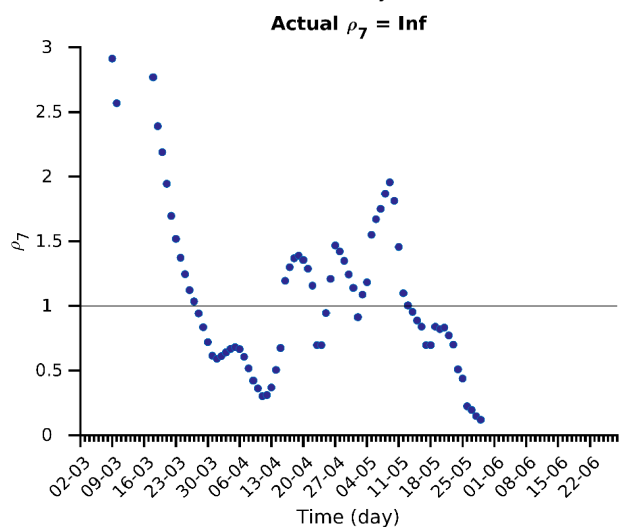
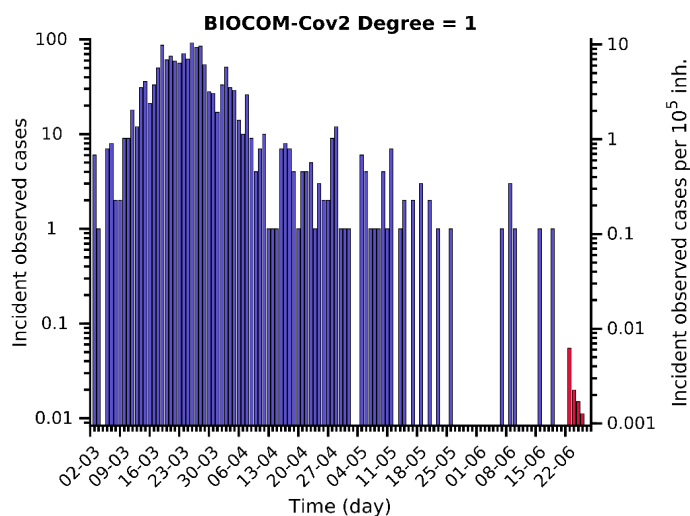
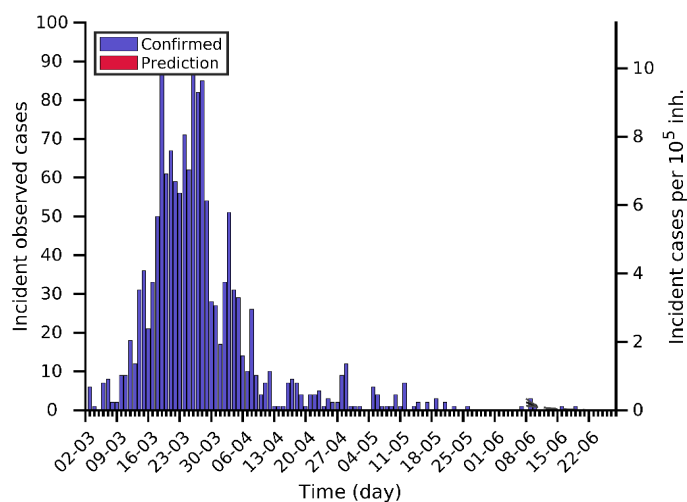
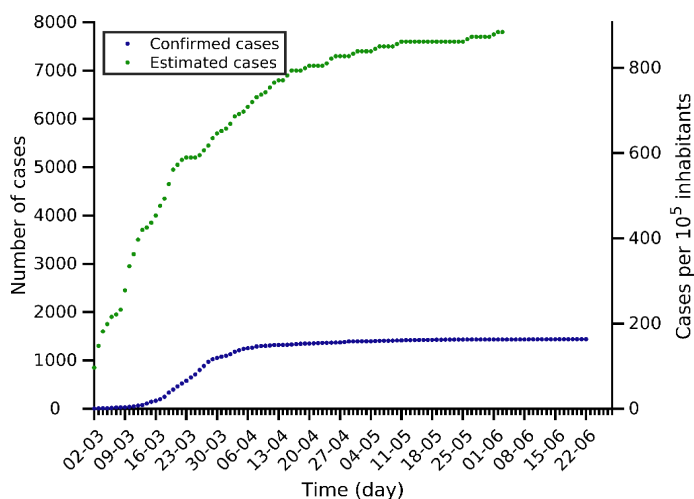
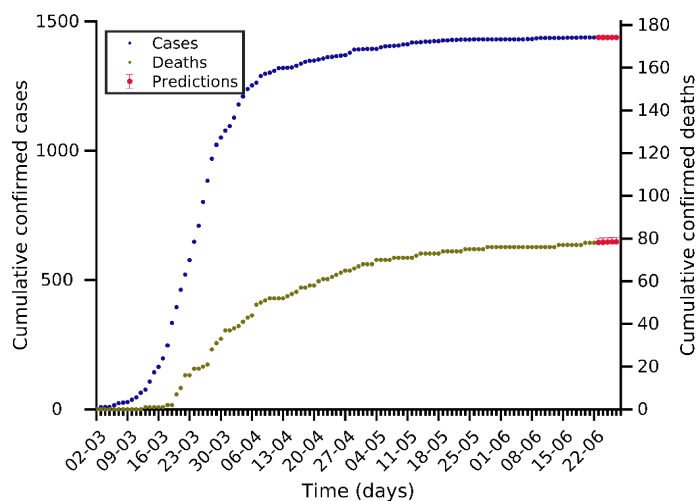
Sicilia 22-06-2020. Population: 5.0M. Current cumulative incidence: 61/10⁵



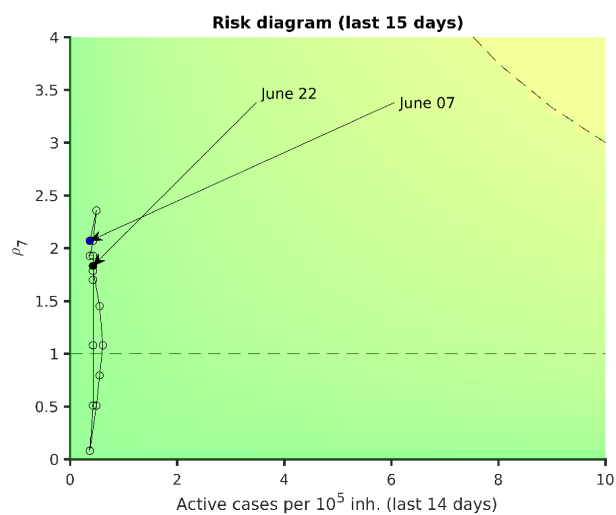
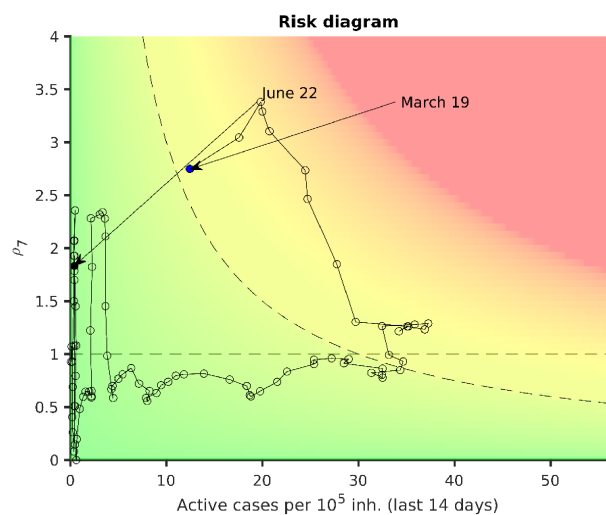
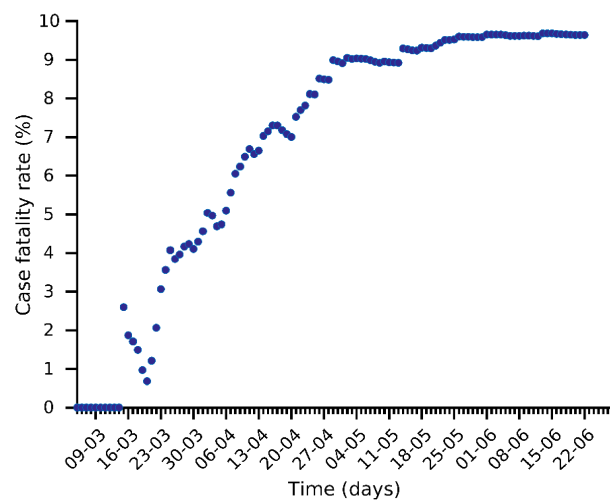
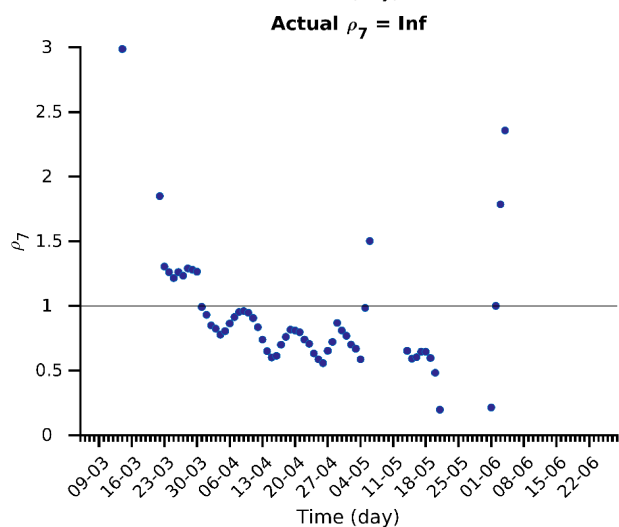
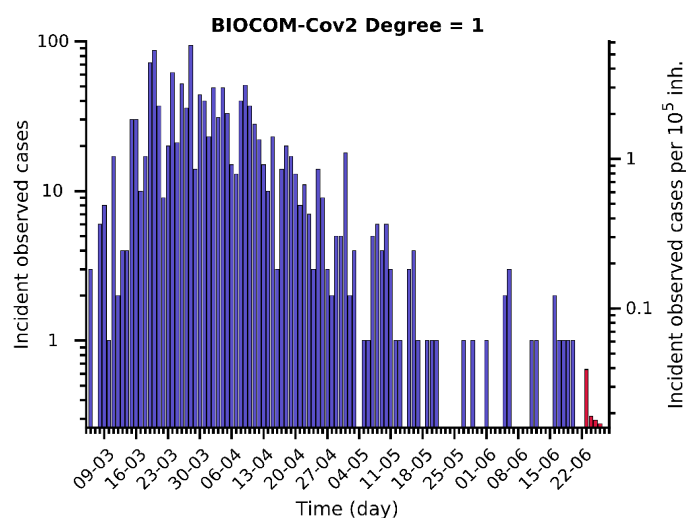
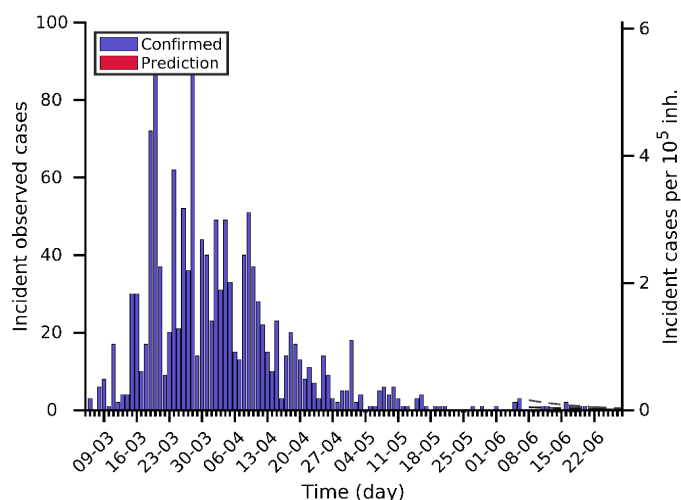
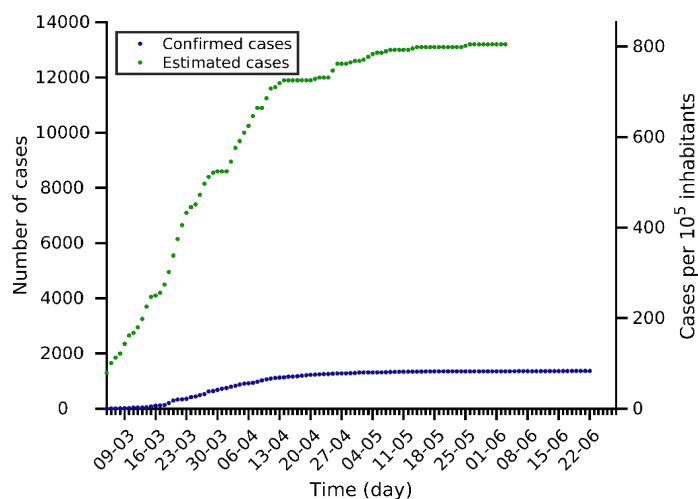
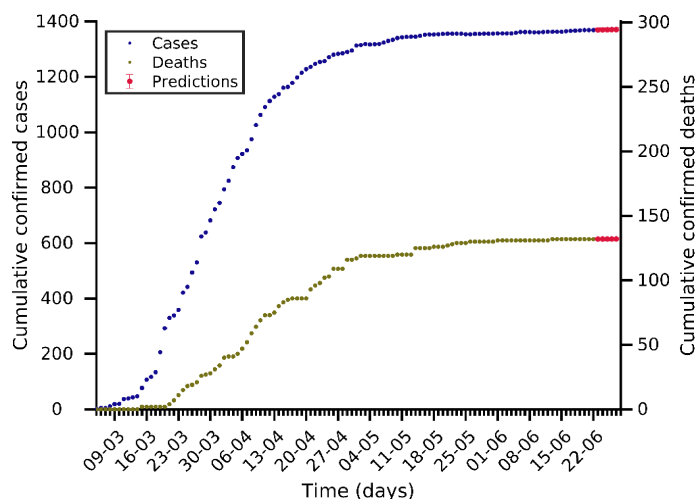
Bolzano 22-06-2020. Population: 0.5M. Current cumulative incidence: 505/10⁵



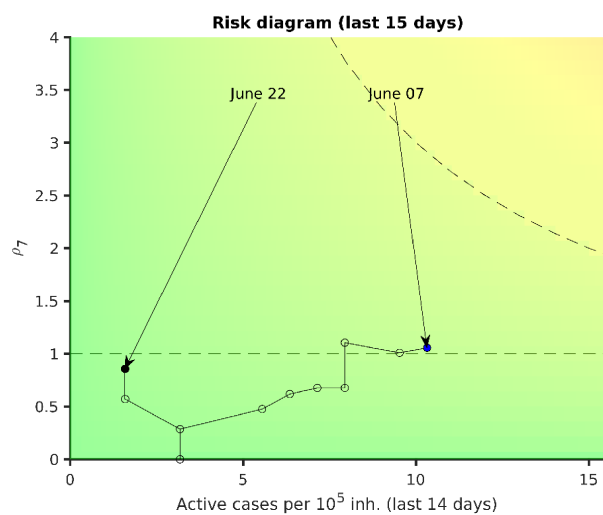
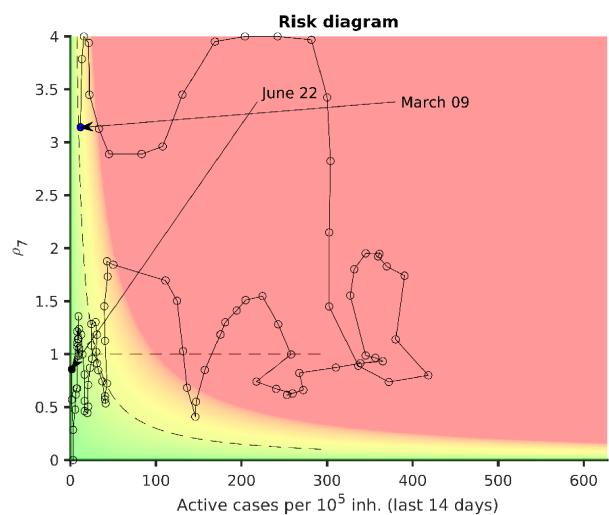
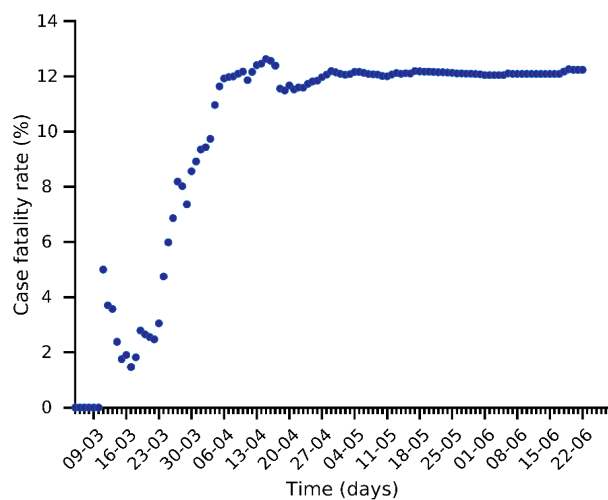
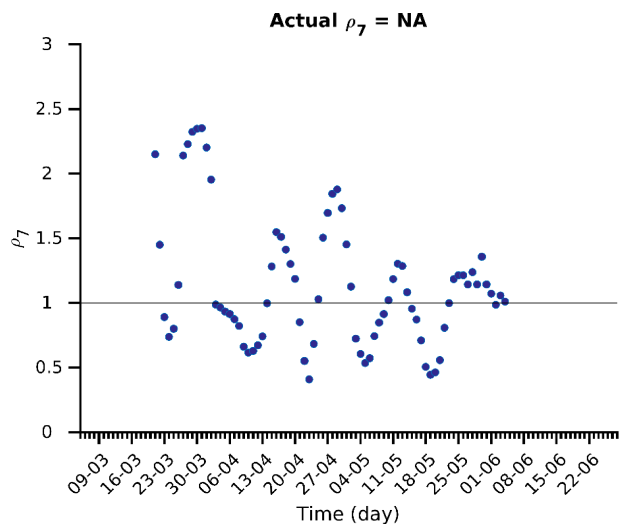
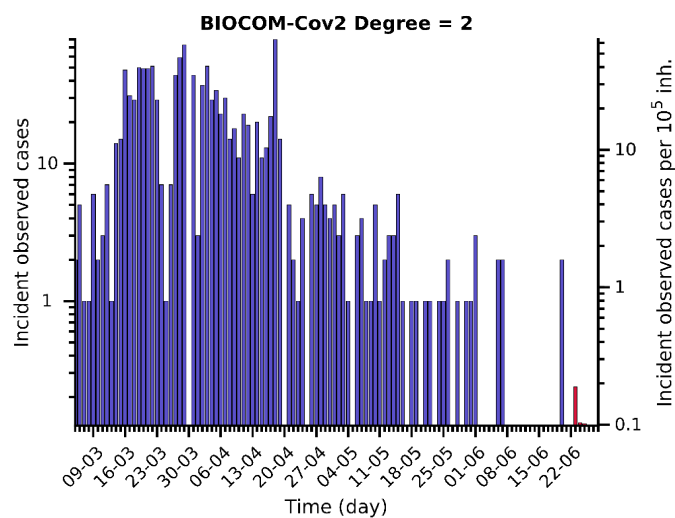
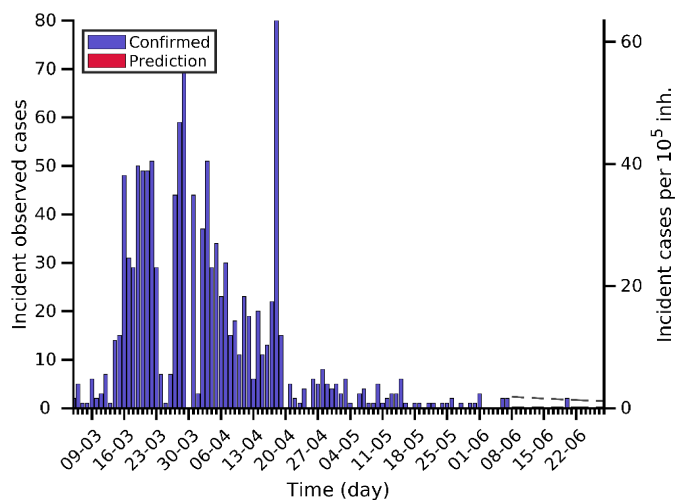
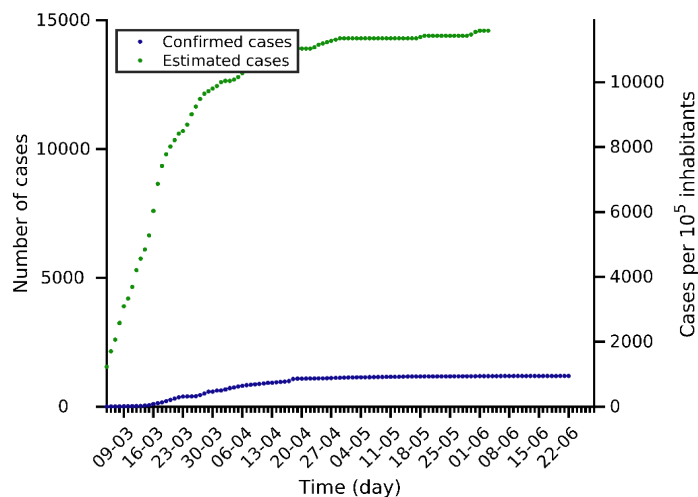
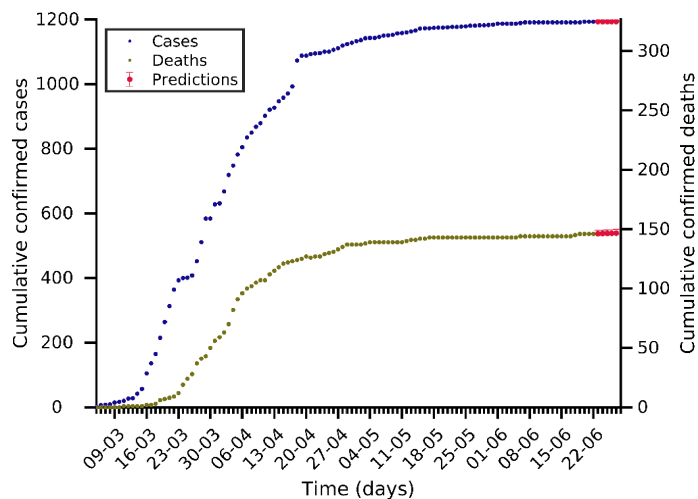
Umbria 22-06-2020. Population: 0.9M. Current cumulative incidence: 163/10⁵



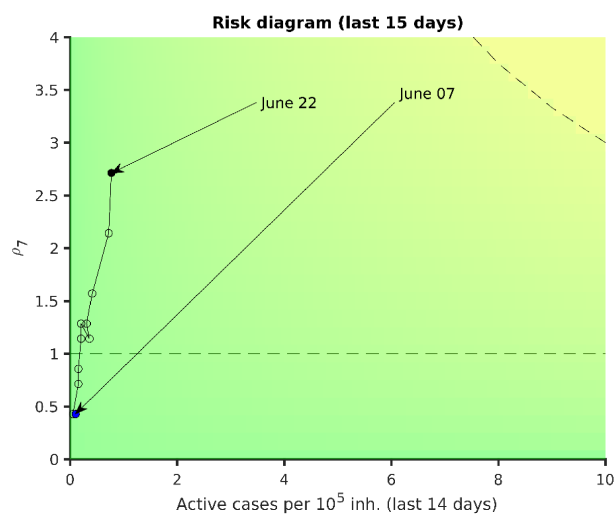
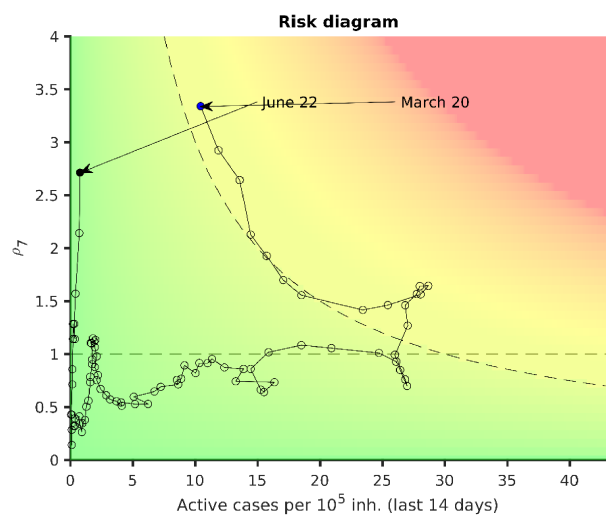
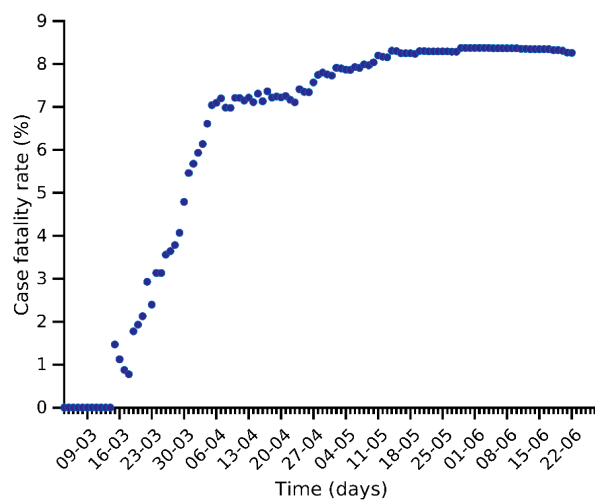
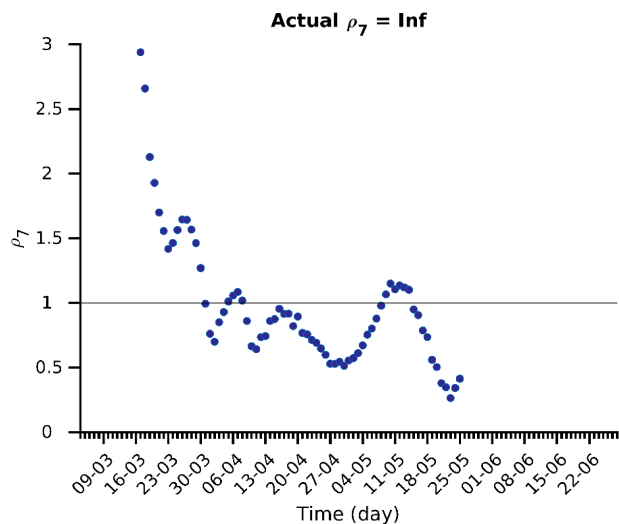
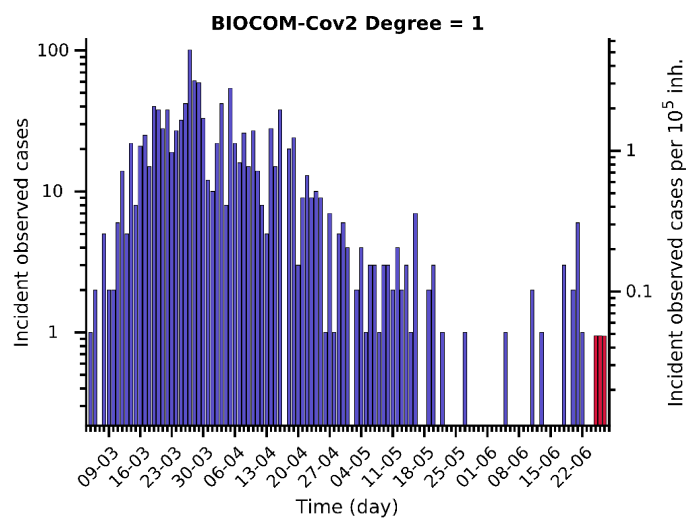
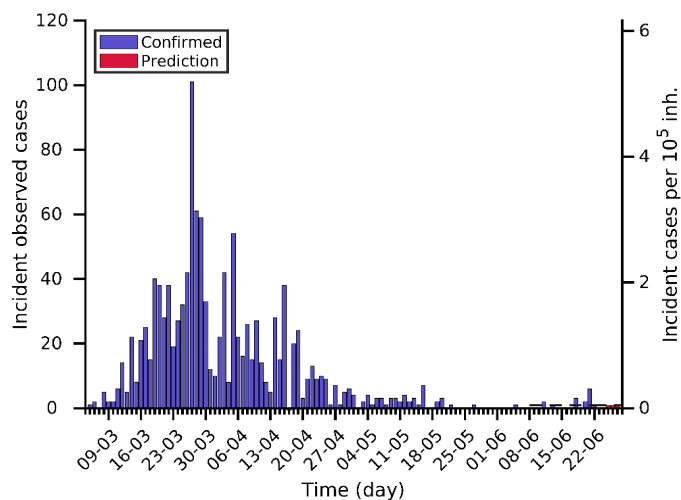
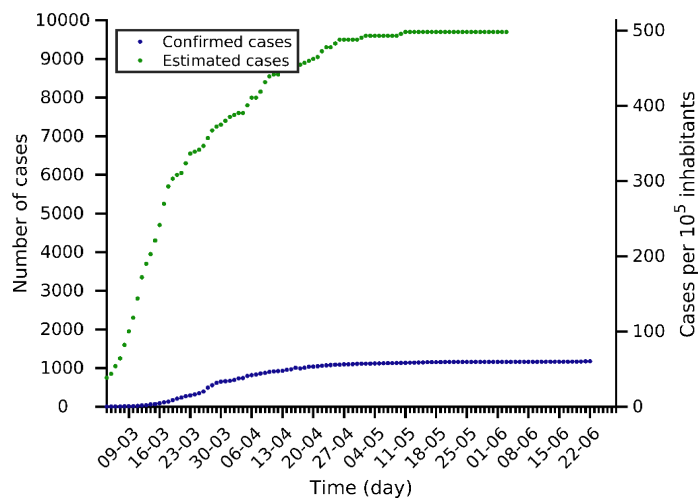
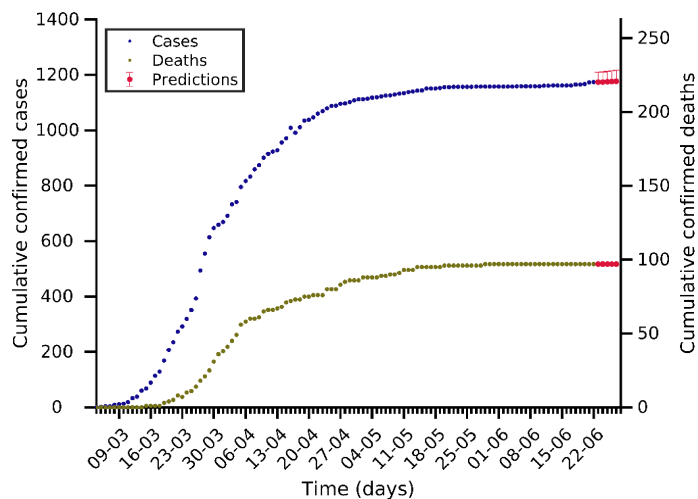
Sardegna 22-06-2020. Population: 1.6M. Current cumulative incidence: 83/10⁵



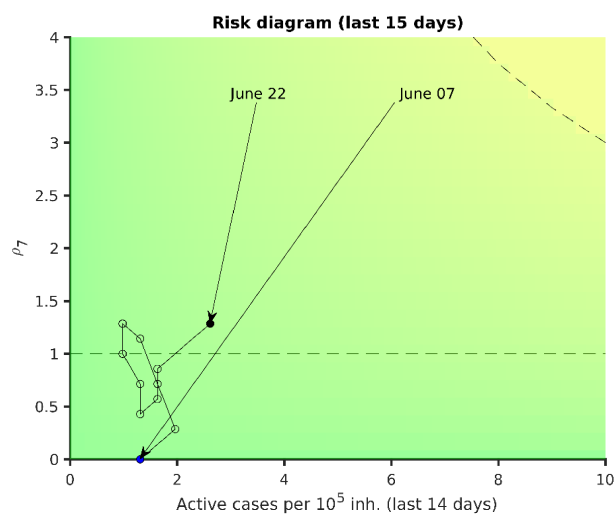
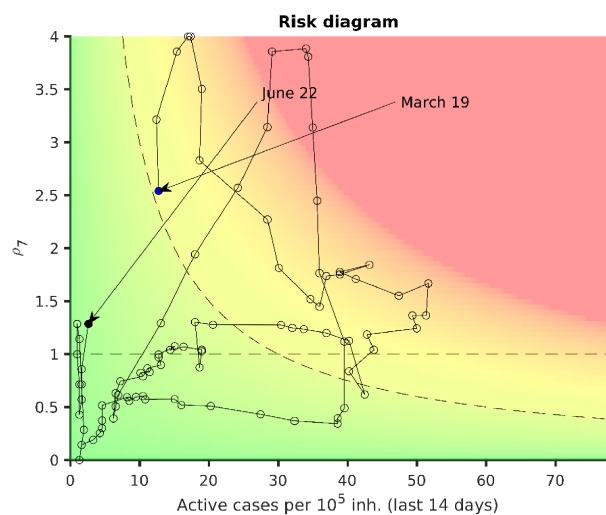
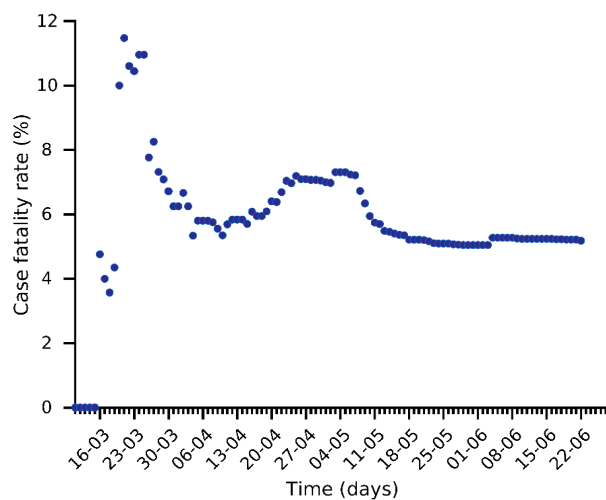
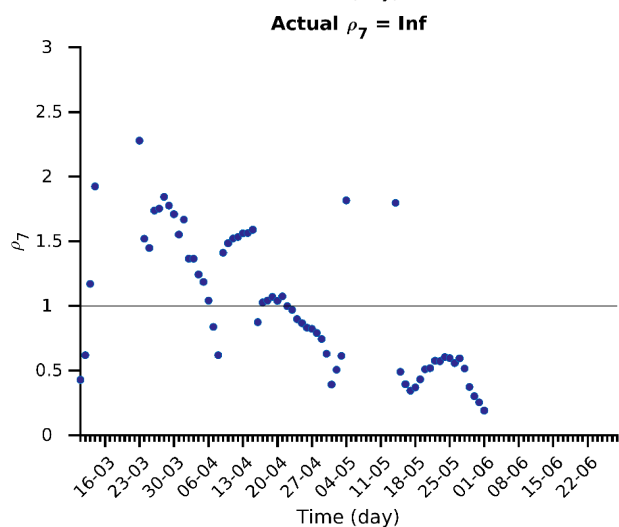
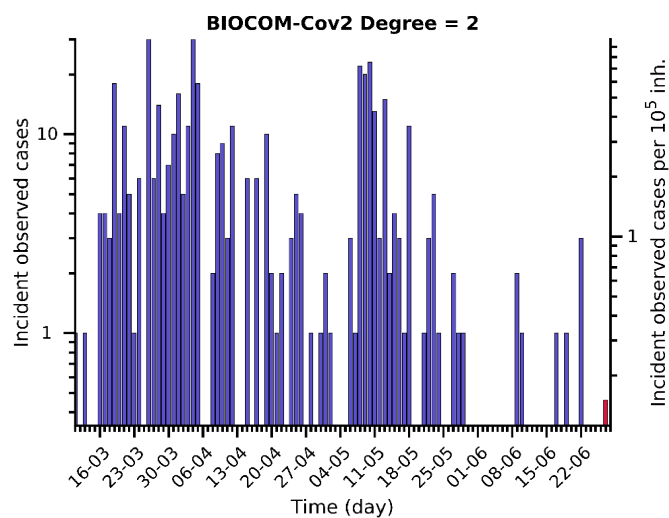
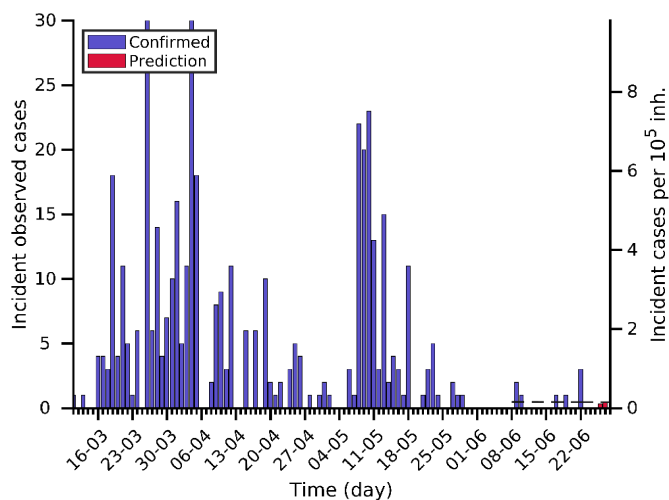
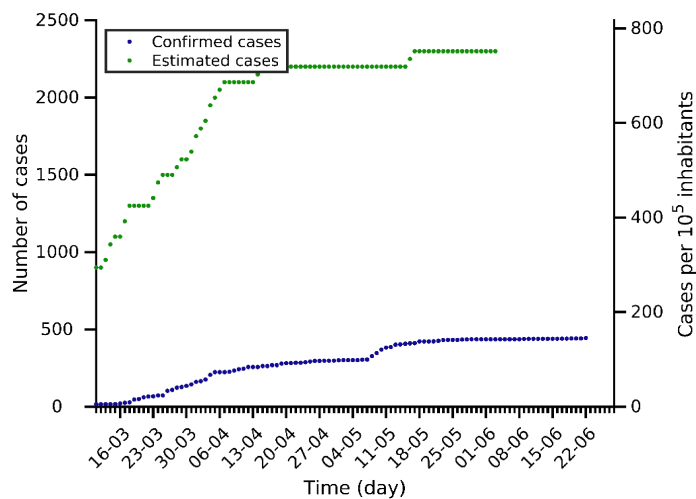
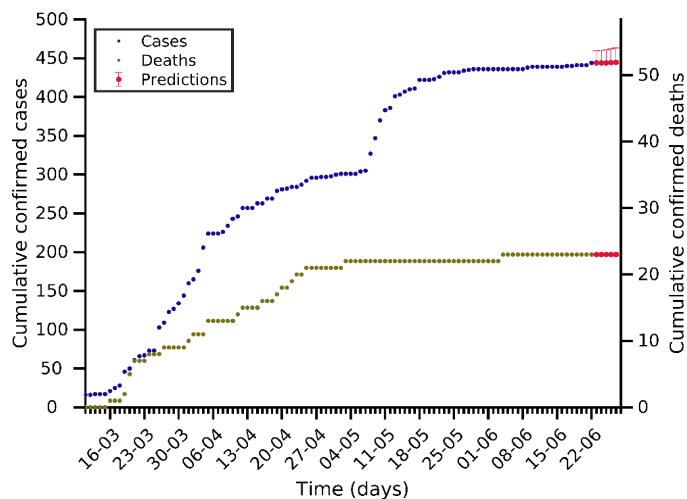
Valle d'Aosta 22-06-2020. Population: 0.1M. Current cumulative incidence: 947/10⁵



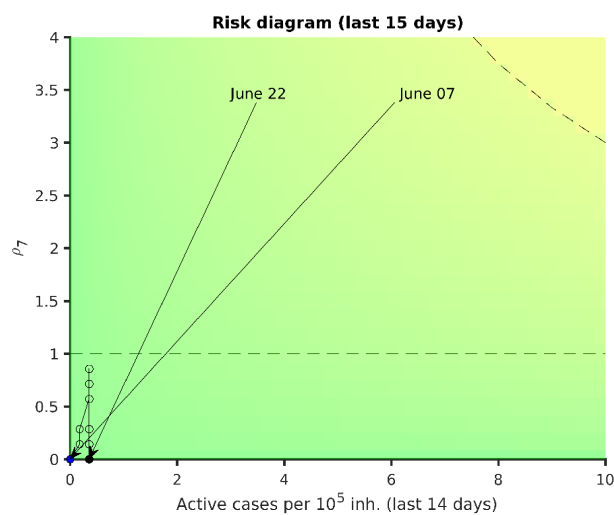
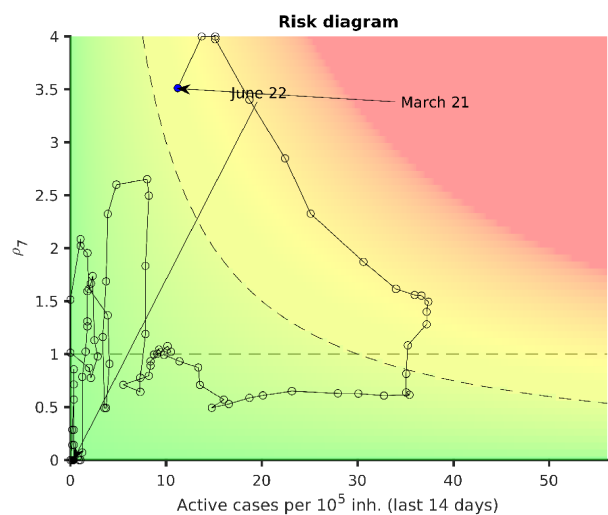
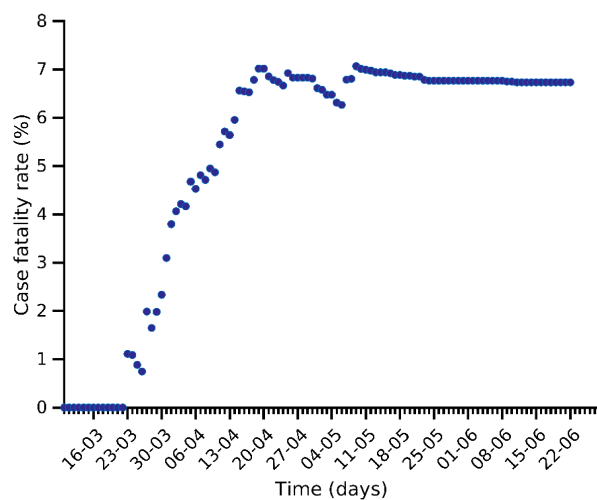
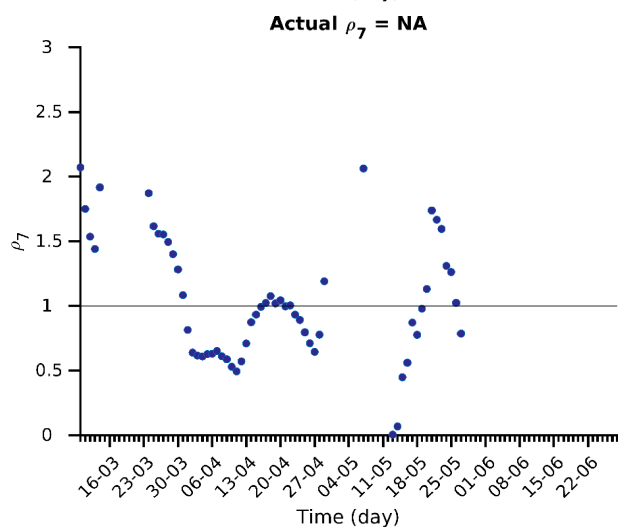
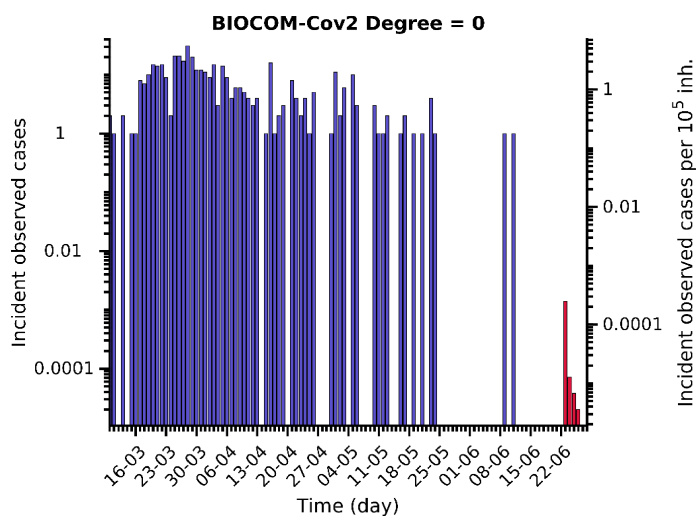
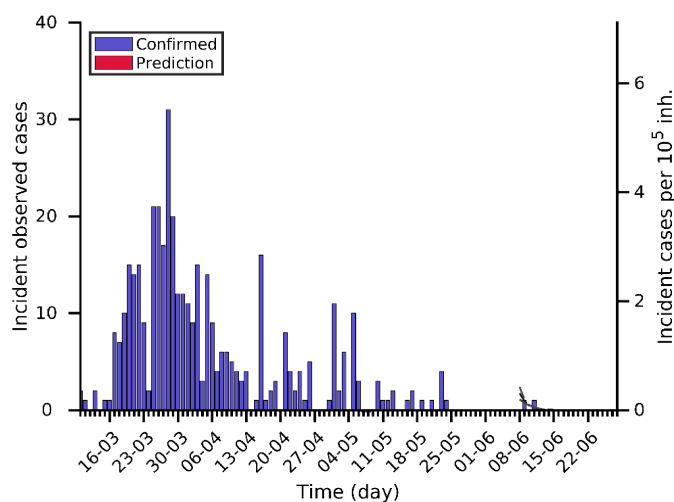
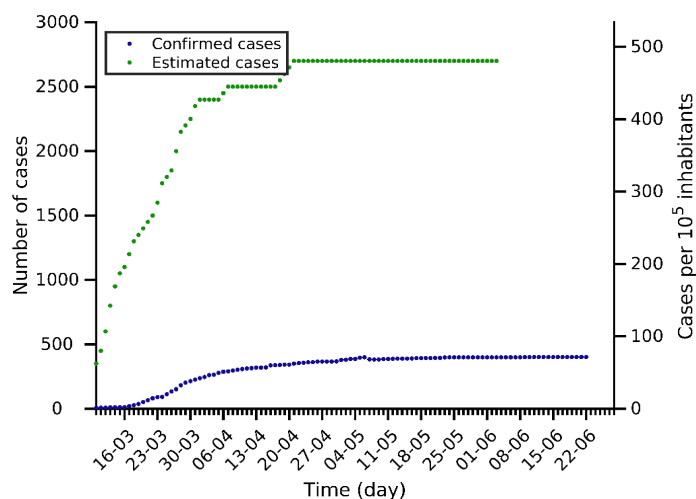
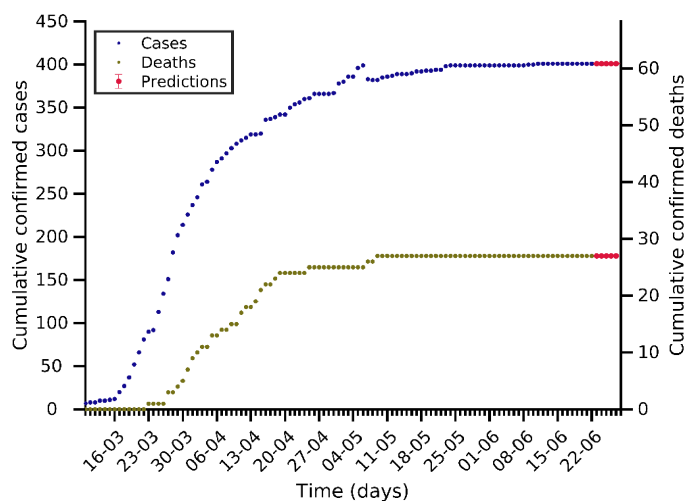
Calabria 22-06-2020. Population: 1.9M. Current cumulative incidence: 60/10⁵



Molise 22-06-2020. Population: 0.3M. Current cumulative incidence: 145/10⁵



Basilicata 22-06-2020. Population: 0.6M. Current cumulative incidence: 71/10⁵



Methods

Methods

(1) Data source

Data are daily obtained from World Health Organization (WHO) surveillance reports¹, from European Centre for Disease Prevention and Control (ECDC)² and from Ministerio de Sanidad³. These reports are converted into text files that can be processed for subsequent analysis. Daily data comprise, among others: total confirmed cases, total confirmed new cases, total deaths, total new deaths. It must be considered that the report is always providing data from previous day. In the document we use the date at which the datapoint is assumed to belong, i.e., report from 15/03/2020 is giving data from 14/03/2020, the latter being used in the subsequent analysis.

(2) Data processing and plotting

Data are initially processed with Matlab in order to update timeseries, i.e., last datapoints are added to historical sequences. These timeseries are plotted for EU individual countries and for the UE as a whole:

- ✓ Number of cumulated confirmed cases, in blue dots
- ✓ Number of reported new cases
- ✓ Number of cumulated deaths

Then, two indicators are calculated and plotted, too:

- ✓ Number of cumulated deaths divided by the number of cumulated confirmed cases, and reported as a percentage; it is an indirect indicator of the diagnostic level.
- ✓ ρ : this variable is related with the reproduction number, i.e., with the number of new infections caused by a single case. It is evaluated as follows for the day before last report ($t-1$):

$$\rho(t-1) = \frac{N_{new}(t) + N_{new}(t-1) + N_{new}(t-2)}{N_{new}(t-5) + N_{new}(t-6) + N_{new}(t-7)}$$

where $N_{new}(t)$ is the number of new confirmed cases at day t .

(3) Classification of countries according to their status in the epidemic cycle

The evolution of confirmed cases shows a biphasic behaviour:

- (I) an initial period where most of the cases are imported;
- (II) a subsequent period where most of new cases occur because of local transmission.

Once in the stage II, mathematical models can be used to track evolutions and predict tendencies. Focusing on countries that are on stage II, we classify them in three groups:

- Group A: countries that have reported more than 100 cumulated cases for 10 consecutive days or more;
- Group B: countries that have reported more than 100 cumulated cases for 7 to 9 consecutive days;
- Group C: countries that have reported more than 100 cumulated cases for 4 to 6 days.

¹ <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>

² <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>

³ <https://www.mscbs.gob.es/profesionales/saludPublica/ccayes/alertasActual/nCov-China/situacionActual.htm>
<https://github.com/datadista/datasets/tree/master/COVID%2019> , <https://covid19.isciii.es/>

(4) Fitting a mathematical model to data

Previous studies have shown that Gompertz model⁴ correctly describes the Covid-19 epidemic in all analysed countries. It is an empirical model that starts with an exponential growth but that gradually decreases its specific growth rate. Therefore, it is adequate for describing an epidemic that is characterized by an initial exponential growth but a progressive decrease in spreading velocity provided that appropriate control measures are applied.

Gompertz model is described by the equation:

$$N(t) = K e^{-\ln\left(\frac{K}{N_0}\right) \cdot e^{-a \cdot (t-t_0)}}$$

where $N(t)$ is the cumulated number of confirmed cases at t (in days), and N_0 is the number of cumulated cases the day at day t_0 . The model has two parameters:

- ✓ a is the velocity at which specific spreading rate is slowing down;
- ✓ K is the expected final number of cumulated cases at the end of the epidemic.

This model is fitted to reported cumulated cases of the UE and of countries in stage II that accomplish two criteria: 4 or more consecutive days with more than 100 cumulated cases, and at least one datapoint over 200 cases. Day t_0 is chosen as that one at which $N(t)$ overpasses 100 cases. If more than 15 datapoints that accomplish the stated criteria are available, only the last 15 points are used. The fitting is done using Matlab's Curve Fitting package with Nonlinear Least Squares method, which also provides confidence intervals of fitted parameters (a and K) and the R^2 of the fitting. At the initial stages the dynamics is exponential and K cannot be correctly evaluated. In fact, at this stage the most relevant parameter is a . Fitted curves are incorporated to plots of cumulative reported cases with a dashed line. Once a new fitting is done, two plots are added to the country report:

- ✓ Evolution of fitted a with its error bars, i.e., values obtained on the fitting each day that the analysis has been carried out;
- ✓ Evolution of fitted K with its error bars, i.e., values obtained on the fitting each day that the analysis has been carried out; if lower error bar indicates a value that is lower than current number of cases, the error bar is truncated.

These plots illustrate the increase in fittings' confidence, as fitted values progressively stabilize around a certain value and error bars get smaller when the number of datapoints increases. In fact, in the case of countries, they are discarded and set as "Not enough data" if $a > 0.2 \text{ day}^{-1}$, if $K > 10^6$ or if the error in K overpasses 10^6 .

It is worth to mention that the simplicity of this model and the lack of previous assumptions about the Covid-19 behaviour make it appropriate for universal use, i.e., it can be fitted to any country independently of its socioeconomic context and control strategy. Then, the model is capable of quantifying the observed dynamics in an objective and standard manner and predicting short-term tendencies.

(5) Using the model for predicting short-term tendencies

The model is finally used for a short-term prediction of the evolution of the cumulated number of cases. The predictions increase their reliability with the number of datapoints used in the fitting. Therefore, we consider three levels of prediction, depending on the country:

⁴ Madden LV. Quantification of disease progression. *Protection Ecology* 1980; **2**: 159-176.

- Group A: prediction of expected cumulated cases for the following 3-5 days⁵;
- Group B: prediction of expected cumulated cases for the following 2 days;
- Group C: prediction of expected cumulated cases for the following day.

The confidence interval of predictions is assessed with the Matlab function `predint`, with a 99% confidence level. These predictions are shown in the plots as red dots with corresponding error bars, and also gathered in the attached table. For series longer than 9 timepoints, last 3 points are weighted in the fitting so that changes in tendencies are well captured by the model.

(6) Estimating non-diagnosed cases

Lethality of Covid-19 has been estimated at around 1 % for Republic of Korea and the Diamond Princess cruise. Besides, median duration of viral shedding after Covid-19 onset has been estimated at 18.5 days for non-survivors⁶ in a retrospective study in Wuhan. These data allow for an estimation of total number of cases, considering that the number of deaths at certain moment should be about 1 % of total cases 18.5 days before. This is valid for estimating cases of countries at stage II, since in stage I the deaths would be mostly due to the incidence at the country from which they were imported. We establish a threshold of 50 reported cases before starting this estimation.

Reported deaths are passed through a moving average filter of 5 points in order to smooth tendencies. Then, the corresponding number of cases is found assuming the 1 % lethality. Finally, these cases are distributed between 18 and 19 days before each one.

⁵ At this moment we are testing predictions at 4 days for countries with more than 100 cumulated cases for 13-15 consecutive days, and 5 days for 16 or more days.

⁶ Zhou et al., 2020. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. The Lancet; March 9, doi: 10.1016/S0140-6736(20)30566-3